BIOLOGY

10TH CLASS

Faderal Board Islamabad

Presented by:

Urdu Books Whatsapp Group

STUDY GROUP

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REVIEW QUESTIONS
MULTIPLE CHOICE QUESTIONS

1. The process of gaseous exchange involves:
   - (a) Breakdown of C-H bonds to yield energy
   - (b) Physical movements that take air in and out of body
   - (c) Getting oxygen from the air and removing carbon dioxide
   - (d) Transport of oxygen by the blood to different parts of the body
2. Most of the gaseous exchange in a leaf occurs through:
   - (a) Stomata (b) General surface
   - (c) Cuticle (d) Lenticels
3. How many bronchi are there in the air passageway?
   - (a) One (b) Two
   - (c) Many (d) None
4. Where does the gaseous exchange occur in humans?
   - (a) Pharynx (b) Trachea
   - (c) Bronchi (d) Alveoli
5. Which structure actively helps in taking the air out of lungs?
   - (a) Nasal cavity (b) Bronchus
   - (c) Bronchiole (d) Diaphragm
6. The primary chemical stimulus for breathing is the concentration of:
   - (a) Carbon dioxide in blood (b) Oxygen in blood
   - (c) Carbon dioxide in muscles (d) Oxygen in muscles
7. Point out the FALSE statement about respiration.
   - (a) Gases can easily pass through the walls of the alveoli
   - (b) Gas exchange in lungs is very efficient because lungs provide large surface
   - (c) In emphysema the walls of alveoli break and there is more surface area
   - (d) Dust particles can damage the lung by irritating the inner alveoli surface
8. A disease involving the breakdown of air sacs of the lungs is:
   - (a) Pneumonia (b) Bronchitis
   - (c) Asthma (d) Emphysema
9. Which process does NOT occur in the nasal cavity?
   - (a) Trapping of large dust Particles
   - (b) Humidification of the inhaled air
   - (c) Warming of the inhaled air
   - (d) Exchange of gases
10. What type of blood vessels surrounds the alveoli?
    - (a) Artery (b) Arteriole
    - (c) Capillary (d) Vein

Answers

1	c	2	a	3	b	4	d	5	d
6	a	7	b	8	d	9	d	10	c

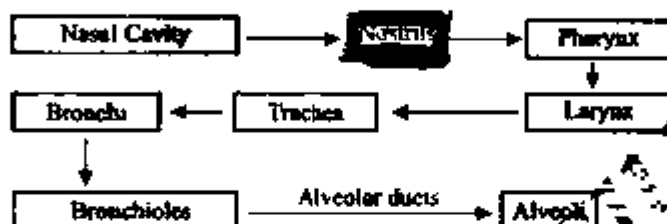
SHORT QUESTIONS

1. [illegible]

Ans: The term breathing is used for the process through which animals take air in their bodies to get Oxygen from it and given out the air for getting rid of carbon dioxide while the cellular respiration is a process by which C-H bonds are broken in oxidation reduction reactions and energy is produced in form of ATP.

2. [illegible]

Ans:

3. [illegible]

Ans: Stoma	Lenticels
1. Small opening in the leaves are called Stomata	1. Pores in the bark of wooding stems and mature roots called Lenticels.
2. Pores are present in Stoma	2. Air spaces are present in Lenticels.
3. Stoma allows the water and gases to pass through it.	3. Lenticels just only allows the gases to pass through it.

UNDERSTANDING THE CONCEPT

1. [illegible] exchange gases with the [illegible]

Ans: See Question No. 2, for answer.

2. [illegible]

Ans: See Question No. [illegible] for answer.

3. [illegible] causes and treatments of bronchitis, emphysema and [illegible]

Ans: See Question No. 5, 6, 7 for answer.

4. How [illegible] respiratory system?

Ans: See Question No. 10, for answer.

ACTIVITIES

1. Investigate the effect of light on the net gaseous exchange from leaf, by using bicarbonate as the indicator.
2. Investigate the breathing rate at rest and after exercise.
3. Find out how much air a person can take into his lungs.
4. Demonstrate through experiment that carbon dioxide is exhaled during respiration

Note: All these activities are related to practicals'.
For answers consult "Alif Key Stone" practical notebook .

ADDITIONAL MULTIPLE CHOICE QUESTIONS

1. Organisms need energy in the form of :
   (a) AMP (b) ADP (c) ATP (d) ANP
2. During cellular respiration ____ bond in the food is broken and ATP is formed.:
   (a) C-N (b) C-H (c) N-H (d) C-P
3. The leaves have small opening which are called:
   (a) Pores (b) Air spaces
   (c) Chambers (d) Stomata
4. Stomata are found in:
   (a) Mesophyll cells (b) Spongy cells
   (c) Lenticels (d) Cuticle
5. Respiratory system of humans is divided into two parts which are:
   (a) Air passage and lungs (b) Nasal cavity and nostrils
   (c) Epiglottis and glottis (d) None of the above
6. The Nose of human encloses:
   (a) Nostrils (b) Nasal cavity (c) Mouth (d) Hairs
7. The Nasal cavity opens into:
   (a) Larynx (b) Glottis
   (c) Pharynx (d) Oral cavity
8. Pharynx is a ____ passage:
   (a) Muscular (b) Lungs (c) Bony (d) All
9. The glottis is guarded by a flap of tissue called:
   (a) Upper glottis (b) Lower glottis (c) Epiglottis (d) All
10. Larynx leads to ____
    (a) Pharynx (b) Trachea
    (c) Voice box (d) Bronchi
11. The Singular of Bronchi is:
    (a) Bronchus (b) Bronchioles
    (c) Bronchioles (d) None of the above
12. Bronchi continues to divide and form small tubes called:
    (a) Alveolar ducts (b) Alveoli
    (c) Bronchioles (d) None of the above
13. Each alveolar duct opens into a cluster of pouches called:
    (a) Alveoli (b) Bronchi
    (c) Bronchioles (d) All
14. Pulmonary Artery carried ____ :
    (a) Oxygenated (b) De-oxygenated
    (c) Lymph (d) None
15. Ribs muscles are called:
    (a) Intercoastal diaphragm (b) Skeletal muscle
    (c) Cardiac muscle (d) Intercoastal muscles
16. A thick muscular structure which separates thorax to the abdominal cavity is named as:
    (a) Ribs (b) Thoraxes cavity (c) Diaphragm (d) All

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گروپ میں کسی بھی قادیانی، مرزائی، احمدی، گستاخِ رسول، گستاخِ امہات المؤمنین، گستاخِ صحابہ و خلفائے راشدین حضرت ابو بکر صدیق، حضرت عمر فاروق، حضرت عثمان غنی، حضرت علی المرتضیٰ، حضرت حسنین کریمین رضوان اللہ تعالیٰ اجمعین، گستاخ اہلبیت یا ایسے غیر مسلم جو اسلام اور پاکستان کے خلاف پراپیگنڈا میں مصروف ہیں یا ان کے روحانی و ذہنی سپورٹرز کے لئے کوئی گنجائش نہیں ہے لہذا ایسے اشخاص بالکل بھی گروپ جوائن کرنے کی زحمت نہ کریں۔ معلوم ہونے پر فوراً ریموو کر دیا جائے گا۔

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- عمران سیریز کے شوقین کیلئے علیحدہ سے عمران سیریز گروپ موجود ہے۔
- **لیڈیز کے لئے الگ گروپ کی سہولت موجود ہے جس کے لئے ویریفکیشن ضروری ہے۔**
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نوٹ: ہمارے کسی گروپ کی کوئی فیس نہیں ہے۔ سب فی سبیل اللہ ہے

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اللہ تبارک تعالیٰ ہم سب کا حامی و ناصر ہو

17. Taking in of the air is termed as:
- (a) Inspiration (b) Expiration
- (c) Breathing (d) Respiration

18. The impure air is expelled out in:
- (a) Exhalation (b) Inhalation
- (c) Inspiration (d) Breathing

19. In normal circumstances the humans breath ____ times per minute:
- (a) 18-20 (b) 20-25 (c) 25-30 (d) 16-20

20. Two types of bronchitis are named as:
- (a) Acute and normal Bronchitis
- (b) Normal and Chronic Bronchitis
- (c) Acute and Chronic Bronchitis
- (d) None of these

21. ______ is the destruction of walls of Alveoli:
- (a) Emphysema (b) Bronchitis
- (c) Pneumonia (d) Asthma

22. Pneumonia is an infection of ______:
- (a) Lungs (b) Bronchi (c) Kidney (d) Liver

23. The form of Allergy is called:
- (a) Asthma (b) Emphysema
- (c) Pneumonia (d) Bronchitis

24. Smoking causes:
- (a) Weakness (b) Sleeping sickness
- (c) Lungs Cancer (d) Asthma

25. Lungs Cancer causes ______ millions deaths worldwide annually:
- (a) 1.3 (b) [illegible] (c) 3.1 (d) 2.5

ANSWERS

1	c	[illegible]	b	3	d	4	a	5	a
6	[illegible]	7	c	8	a	9	c	10	b
11	a	12	c	13	a	14	a	15	d
16	c	17	a	18	a	19	d	20	c
21	a	22	a	23	a	24	c	25	a

ADDITIONAL SHORT ANSWERS

1. Define Gaseous Exchange.

Ans: It is a process of taking in oxygen and giving out of carbon dioxide is termed as **gaseous exchange.**

2. Define Breathing. Is breathing synonymous to respiration?

Ans: The term breathing is used for the process through which animals take air in their bodies to get oxygen from it and then give out the air for getting rid of carbon dioxide. Thus breathing and respiration are not synonymous.

3. What is cellular respiration?

Ans: Cellular respiration is the process in which the C-H bonds in food are broken by oxidation reduction reactions and the energy is transformed into ATP. In aerobic

respiration, oxygen is used and there is complete oxidation of the food material. Carbon dioxide and water are also produced in this process.

4. **What is Stomata?**

Ans: These are small opening in the walls of the leaves. The leaves and young stems have stomata in their epidermis. The gaseous exchange occurs through these stomata.

5. **How Gases Exchange occurs by roots?**

Ans: Gases diffuse in and out of the general surface of the young roots. The gases are found in the soil surrounding the roots so, roots play an important role in gaseous exchange.

6. **Define Nasal cavity**

Ans: The nose encloses the nasal cavity. It opens to the outside through the openings called the **nostrils**. The nasal cavity is divided into two portions by a wall. Each portion is lined by fine hairs and mucous which filter the dust particles from the air.

7. **What is Nostril?**

Ans: The nose encloses the **nasal cavity**. It opens to the outside through the openings called the **nostrils**.

8. **What is Pharynx?**

Ans: The nasal cavity opens into the **pharynx** by means of two small openings called internal nostrils. Pharynx is a muscular organ and is connected to both food and air It extends to the opening of the oesophagus and the .

9. **What is voice box?**

Ans: The larynx is a box, made of cartilage. It is present between pharynx and trachea. It is also called the **voice box.**

10. **Define Bronchi.**

Ans: On entering the chest cavity, the trachea divides into two smaller tubes called **bronchi** *(Singular:* bronchus). The bronchi also have cartilagenous plates in their walls. Each bronchus enters into the lung of its side and then divides into smaller branches.

11. **What are Bronchioles?**

Ans: The bronchi continue dividing in the lungs until they make several fine tubes called **bronchioles.**

12. **Define Alveolar duct**

Ans: The bronchioles progressively lose the cartilages as they become narrower. The bronchioles end as fine tubules called the **alveolar ducts.**

13. **What is Alveoli?**

Ans: Each alveolar duct opens into a cluster of pouches called **alveoli.**

14. **What are Inter coastal muscle?**

Ans: There is a pair of lungs in the thoracic cavity. The chest wall is made up of 12 pairs of **ribs** and the rib muscles called **intercoastal muscles.**

15. **Define Lungs.**

Ans: All the alveoli on one side constitute a lung. The two lungs are present in human body.

16. **What is Inspiration?**

Ans: It is a process by which air is taken inside the body.

17. **What is Expiration?**

Ans: After the gaseous exchange in the lungs, the impure air is expelled out in exhalation

18. Define Bronchitis.

Ans: Bronchitis is the inflammation of the bronchi or bronchioles. It results in excessive secretions of mucus into the tubes, leading to the swelling of tubular walls and narrowing of tubes.

19. What are causes of Bronchitis?

Ans: It is caused by viruses, bacteria or exposure to chemical irritant.

20. Differentiate between Acute and Chronic bronchitis.

Ans: **The acute bronchitis** usually lasts about two weeks and patients recovers with no permanent damage to the bronchi or bronchioles.

In chronic bronchitis, the bronchi develop chronic inflammation. It usually lasts for three months to two years.

21. What are symptoms of bronchitis?

Ans: Symptoms of bronchitis include a cough, mild wheezing, fever, chills and shortness of breath.

22. What is Emphysema?

Ans: Emphysema is the destruction of the walls of the alveoli. It results in larger sacs but with less surface area for gaseous exchange. As lung tissue breaks down, the lungs do not come back to their original shape after exhalation. So air cannot be pushed out and is trapped in the lungs.

23. What are symptoms of Emphysema?

Ans: The symptoms of emphysema include shortness of breadth, fatigue, recurrent respiratory infections and weight loss.

24. What is pneumonia?

Ans: Pneumonia is an infection of lungs. If this infection affects both lungs, it is called double pneumonia.

25. Name the bacteria which is cause of pneumonia.

Ans: The most common cause of pneumonia is a bacterium, *Streptococcus pneumoniae*.

26. Define Asthma.

Ans: Asthma is a form of allergy, in which there is inflammation of the bronchi, more mucous production and narrowing of the airways.

27. What are symptoms of Asthma?

Ans: The symptoms of asthma vary from person to person. The major symptoms include shortness of breath, wheezing, cough and chest tightness.

28. What is lung cancer?

Ans: Lung cancer is a disease of uncontrolled cell divisions in the tissues of the lung. The cells continue to divide without any control and form tumours. The cellular growth may also invade adjacent tissues beyond the lungs.

29. What are symptoms of Lung cancer?

Ans: The most common symptoms are shortness of breath, coughing (including coughing up blood) and weight loss.

30. What is Arteriole sclerosis?

Ans: Many other chemicals in smoke increase the production of blood platelets. When platelets are more than the normal numbers, they make the blood viscous and it can lead to arteriosclerosis.

REVIEW QUESTIONS
MULTIPLE CHOICE

1. **The human urinary system consists of:**
   - (a) Rectum, lungs, kidneys, ureters
   - (b) Kidneys, ureters, urinary bladder
   - (c) Skin, liver, lungs, kidneys
   - (d) Kidneys, ureters, urinary bladder, urethra
2. **Which organ is responsible for filtering the blood?**
   - (a) Intestine (b) Brain
   - (c) Stomach (d) Kidney
3. **The tube between kidney and urinary bladder is the:**
   - (a) Ureter (b) Urethra
   - (c) Renal tubule (d) Nephron
4. **Body balance of water, salts, temperature and glucose is termed as.**
   - (a) Excretion (b) Tubular secretion
   - (c) Homeostasis (d) Re-absorption
5. **Which is the correct order for the path taken by urine after it leaves the kidneys?**
   - (a) Urethra, bladder, ureters (b) Bladder, ureters, urethra
   - (c) Ureters, bladder, urethra (d) Bladder, urethra ureters
6. **What is the function of the ureter?**
   - (a) To store urine
   - (b) To carry urine from the kidney to the bladder
   - (c) To carry urine out of the body
   - (d) To remove waste from the blood
7. **What waste products are excreted by kidneys?**
   - (a) Urea, water & salts (b) Salts, water and carbon dioxide
   - (c) Urea & water (d) Urea & salts
8. **The two main functions of sweat are.**
   - (a) To keep the body cool and to remove excess proteins
   - (d) To keep the body warm and to filter the blood
   - (c) To filter the blood and to remove waste products
   - (d) To remove waste products and to cool the body
9. **Which would NOT be present in the filtrate entering the Bowman's capsule of nephron?**
   - (a) Water (b) Calcium ions (c) Blood cells (d) Urea
10. **During peritoneal dialysis, the waste materials move from:**
    - (a) The abdomen to the dialysis fluid
    - (d) The dialysis fluid to the peritoneum blood vessels
    - (e) The peritoneum blood vessels to the dialysis fluid
    - (d) The dialysis fluid to the abdomen

1	d	2	d	3	a	4	c	5	c
6	b	7	a	8	d	9	c	10	b

SHORT QUESTIONS

1. **What are the major organs involved in homeostasis in human body? State the roles of each of these organs.**

Ans: The following are the main organs which work for homeostasis:

(i) Lungs remove excess carbon dioxide and keep it in balance.
(ii) Skin performs role in the maintenance of body temperature and also removes excess water and salts.
(iii) The kidney filters excess water, salts, urea, uric acid etc. from the blood and forms urine.

2. **Identify and label the following: diagram**

Ans:

UNDERSTANDING THE CONCEPT

1. **Describe the process of selective re-absorption in the kidneys.**

Ans: See Question No. 6, for answer.

2. **How do the plants excrete extra water and salts from their bodies?**

Ans: See Question No. 2, for answer.

3. **What is the functional unit of the kidney? Describe its structure and draw labelled diagram.**

Ans: See Question No. 6, for answer.

4. **What steps are involved in the formation of urine in the kidneys?**

Ans: See Question No. 6, for answer.

5. **"Along with excretion, kidneys also play role in Osmoregulation." Comment on this statement.**

Ans: See Question No. 6, for answer.

ACTIVITIES

1. Examine the structure of kidney (Sheep or goat kidney / model).
2. Trace the movement of a molecule of urea from blood to urethra using a flow chart.

Note: All these activities are related to practicals'.
For answers consult "Alif Key Stone" practical notebook .

SCIENCE, TECHNOLOGY AND SOCIETY

1. Realize the importance of drinking plentiful water daily.
2. Predict how the kidney helps to overcome the problem of dehydration.
3. Recognize the right treatments of kidney problems.

THE TERMS TO KNOW

Bowman's capsule: Part of nephron; cup-shaped structure enclosing the glomerulus.
Collecting duct: The tubes into which the renal tubules of nephrons open.
Dialysis: The cleaning of blood (removing nitrogenous wastes and extra water) by artificial ways.
Dialyzer: The apparatus used for haemodialysis.
Distal convoluted tubule: The last part of the nephron.
Excretion: The process by which the metabolic wastes are removed from the body.

ADDITIONAL MULTIPLE CHOICE QUESTIONS

1. The normal temperature of human body is:
   (a) 38°c (b) 37°c
   (c) 98.6°F (d) 100°F
2. Maintenance of internal conditions of body at equilibrium is called:
   (a) Osmoregulation (b) Thermoregulation
   (c) Respiration (d) Excretion
3. Transpiration usually does not occurs at:
   (a) Day (b) Night
   (c) Monsoon (d) Summer
4. _____ is the loss of water from plant surface in the form of vapours:
   (a) Excretion (b) Guttation
   (c) Transpiration (d) Thermoregulation
5. The plants which are completely submerged in fresh water called:
   (a) Hydrophytes (b) Xerophytes
   (c) Mesophytes (d) Halophytes
6. The plants of deserts are:
   (a) Hydrophytes (b) Xerophytes
   (c) Mesophytes (d) Halophytes
7. Halophytes live in:
   (a) Fresh waters (b) Deserts
   (c) Mountains (d) Sea waters
8. The chemical which is responsible for the shedding of leaves:
   (a) Hydrochloric acid (b) Carbon
   (c) Oxygen (d) Calcium oxalate
9. Epidermis is the layer of:
   (a) Skin (b) Teeth
   (c) Bone (d) Nail
10. Excretory system of humans is also called:
    (a) Respiratory (b) Digestive
    (c) Urinary system (d) None
11. Kidneys are _______ shaped organs:
    (a) Dark red (b) Dark red bean
    (c) Yellow red (d) Yellow red bean
12. Each human kidney weighs about:
    (a) 36 grams (b) 32 grams
    (c) 27 grams (d) 72 grams
13. The length of each kidney is:
    (a) 5 cm (b) 10 cm
    (c) 12 cm (d) 15 cm
14. The width of each kidney is:
    (a) 4 cm (b) 5 cm (c) 6 cm (d) 7 cm
15. The depression of the kidney is:
    (a) Cortex (b) Pyramids
    (c) Pelvis (d) Hilus

16. **Structural and functional unit of kidney is:**
(a) Cortex (b) Pyramids
(c) Pelvis (d) Nephron

17. **There are over _____ million Nephrons in a kidney:**
(a) 2 (b) 1
(c) 3 (d) 4

18. **U-shaped structure is:**
(a) Loop of Henle (b) Glomerulus
(c) Pelvis (d) Nephron

19. **Normal composition of Urine containing sodium ion is:**
(a) 1.17 g /l (b) 1.19 g / l
(c) 1.20 g / l (d) 1.21 g / l

20. **The leading cause of kidney failure is:**
(a) Temperature (b) Diabetes Mellitus
(c) Hypertension (d) Both b and c

ANSWERS

1	c	2	a	3	b	4	c	5	a
6	b	7	d	8	a	9	a	10	c
11	b	12	c	13	c	14	a	15	d
16	d	17	b	18	a	19	a	20	d

ADDITIONAL SHORT ANSWERS

1. **What is Homeostasis?**
Ans: Homeostasis may be defined as the maintenance of the internal conditions of body at equilibrium, despite changes in the external environment.

2. **Define Osmoregulation.**
Ans: It is maintenance of the amounts of water and salts in body fluids (i.e. blood and tissue fluids).

3. **Define Thermoregulation.**
Ans: The maintenance of internal body temperature is called thermoregulation. The enzymes of body work best at particular temperatures (optimum temperature).

4. **Define Excretion.**
Ans: Excretion is also a process of homeostasis. In this process, the metabolic wastes are eliminated from body to maintain the internal conditions at equilibrium.

5. **What is Guttation.**
Ans: Some plants such as grasses force this water through special pores, present at leaf tips or edges, and form drops. The appearance of drops of water on the tips or edges of leaves is called **guttation.**

6. **Define Hydrophytes.**
Ans: **Hydrophytes** are the plants which live completely or partially submerged in freshwater. Such plants do not face the problem of water shortage. They have developed mechanisms for the removal of extra water from their cells. Hydrophytes have broad leaves with a large number of stomata on their upper surfaces. This

characteristic helps them to remove the extra amount of water.

7. **Define Xerophytes.**

Ans: Xerophytes live in dry environments. They possess thick, waxy cuticle over their epidermis to reduce water loss from internal tissues. They have less number of stomata to reduce the rate of transpiration.

8. **What are Succulent Organs?**

Ans: Some xerophytes have special parenchyma cells in stems or roots in which they store large quantities of water. This makes their stems or roots wet and juicy, called succulent organs.

9. **What is difference between Epidermis and Dermis?**

Ans: **Epidermis:** Epidermis is the outer protective layer without blood vessels.
Dermis: While dermis is the inner layer containing blood vessels, sensory nerve endings, sweat and oil glands, hairs and fat cells.

10. **Define Lungs.**

Ans: In the previous chapter we have learned how lungs maintain the concentration of carbon dioxide in the blood. Our cells produce carbon dioxide when they perform cellular respiration.

11. **Define Urinary System in Humans.**

Ans: The excretory system of humans is also called the urinary system. It is formed of one pair of kidneys, a pair of ureters, a urinary bladder and a urethra. Kidneys filter blood to produce urine and the ureters carry urine from kidneys to urinary bladder. The bladder temporarily stores urine until it is released from body.

12. **What is Hilus?**

Ans: The concave side of kidney faces vertebral column. There is a depression, called hilus.

13. **Define Renal Cortex.**

Ans: Renal cortex is the outer part of kidney and it is dark red in colour.

14. **What is Renal Medulla?**

Ans: Renal medulla is the inner part of kidney and is pale red in colour.

15. **What are Pyramids?**

Ans: Renal medulla consists of several cone shaped areas called renal pyramids.

16. **Define Loops of Henle.**

Ans: Next portion of renal tubule is U-shaped and is called the Loop of Henle. The last portion of renal tubule is the distal convoluted tubule.

17. **Define Pelvis.**

Ans: Many collecting ducts join together to form several hundred papillary ducts which drain into renal pelvis.

18. **What is Pressure Filtration?**

Ans: The first step is pressure filtration. When blood enters the kidney via the renal artery, it goes to many arterioles, and then to the glomerulus.

19. **Define Glomerular Filtrate?**

Ans: The pressure of blood is very high and so most of the water, salts, glucose and urea of blood is forced out of glomerular capillaries. This material passes into the Bowman's capsule and is now called glomerular filtrate.

20. **What is Urine?**

Ans: The filtrate present in renal tubules is known as urine. It moves into collecting ducts and then into pelvis.

REVIEW QUESTIONS
MULTIPLE CHOICE

1. **Processes that carry nerve impulses away from the cell body are called:**
   (a) Axons (b) Dendrites
   (c) Synapses (d) Myelin sheath
2. **The portion of the nervous system that is involuntary in action:**
   (a) Somatic nervous system (b) Motor nervous system
   (c) Autonomic nervous system (d) Sensory nervous system
3. **Which neurons are present inside the central nervous system?**
   (a) Sensory neurons only (b) Motor neurons only
   (c) Sensory and motor neurons both (d) Interneurons only
4. **The part of the brain responsible for muscle movement, interpretation of the senses and the memory is the:**
   (a) Pons (b) Medulla oblongata
   (c) Cerebrum (d) Cerebellum
5. **Apart from hearing, what other major body function is performed by the ear?**
   (a) Hormone secretion (b) Body balance
   (c) Reduction in nerve pressure (d) All of them
6. **The myelin sheath is formed by __ some neurons.**
   (a) Nodes of Ranvier (b) Axons
   (c) Dendrites (d) Schwann cells
7. **This is NOT a part of the hindbrain:**
   (a) Pons (b) Medulla oblongata
   (c) Cerebrum (d) Cerebellum
8. **If you look at an intact human brain, what you see the most is a large, highly convoluted outer surface. This is the:**
   (a) Cerebrum (b) Cerebellum
   (c) Pons (d) Medulla oblongata
9. **Insulin and glucagon are produced in the:**
   (a) Hypothalamus (b) Thyroxin
   (c) Liver (d) Pepsinogen
10. **All of these are hormones except:**
   (a) Insulin (b) Glucagon
   (c) Anterior pituitary (d) Pancreas

ANSWERS

1	a	2	c	3	a	4	c	5	b
6	d	7	c	8	b	9	d	10	d

SHORT QUESTIONS

1. **Identify the two types of coordination in living organisms.**

Ans: There are two types of coordination in organisms:

(i) Nervous coordination

(ii) Chemical co-ordination brought about by endocrine system

2. Differentiate between the modes of nervous and chemical co-ordinations.

Ans: A nerve means the union of several axons that are enveloped by a covering made of lipid while animal have chemical co-ordination system which help them to interact their body parts in a system of work.

3. What are the main components of coordination?

Ans: A coordinated action has five components;

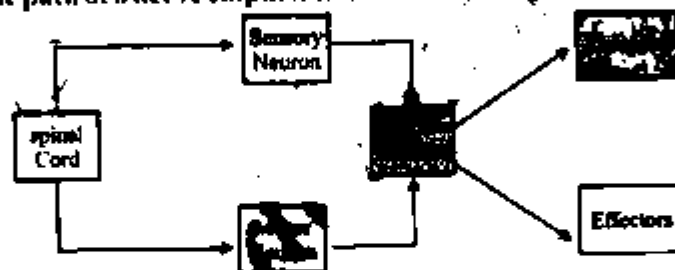
Stimulus —► Receptor — ► Coordinator—► Effector — ► Response

4. Define reflex action and reflex arc.

Ans: Reflex Action: Sometimes, the involuntary response produced by the CNS is very quick. Such a response is called reflex action.

Reflex Arc: The pathway followed by the nerve impulses for producing a reflex action, is called reflex arc.

5. Trace the path of a nerve impulse in case of a reflex action.

Ans:

6. Describe the pupil reflex in dim and bright light.

Ans: Rods and the cones generate the nerve impulses in optic nerves. These impulses are carried to brain which makes the sensation of vision. Rods contain a pigment called rhodopsin. When light fall on rhodopsins it breaks for generating a nerve impulse. In the dim light the pupil reflexes opens the convex lens for light. While in bright light it closes the convex lens.

7. How would you associate the role of vitamin A with vision and effects of its deficiency on retina?

Ans: Body synthesis rhodopsin from vitamin A and that is why the deficiency of vitamin A causes poor night vision. This problem is called night blindness.

8. Define the terms; hormone and endocrine system.

Ans: Hormones: A substance that is secreted by an endocrine gland directly into blood and that produces a specific effect on a particular tissue.

Endocrine: A ductless gland produces and secretes hormones.

UNDERSTANDING THE CONCEPT

1. Explain what can happen if there is no coordination in the activities of organisms.

Ans: See Questions No.13, for Answer.

2. **Explain the location and function of these parts of brain; cerebrum, cerebellum, pituitary gland, thalamus, hypothalamus, medulla oblongata.**

Ans: See Questions No.4. for Answer.

3. **Define neuron and describe the structure of a general neuron.**

Ans: See Questions No.3, for Answer.

4. **Describe the structure of human eye.**

Ans: See Questions No.7, for Answer.

5. **How would you describe the structure of the external, middle and inner ear of man?**

Ans: See Questions No.10, for Answer.

6. **What are short sight and long sight problems and how these can be treated?**

Ans: See Questions No.8, for Answer.

7. **Explain the role of ear in the maintenance of balance.**

Ans: See Questions No.10, for Answer.

8. **Relate the contribution of Ibn-al-Haytham and Al-[illegible] with knowledge about the structure of eye and treatment of various ophthalmic diseases.**

Ans: See Questions No.9, for Answer.

9. **Outline the major glands of the endocrine system (pituitary, thyroid, pancreas, adrenal, gonads), with name of their hormones and their functions.**

Ans: See Questions No.11, for Answer.

10. **Describe negative feedback with reference to insulin and glucagon.**

Ans: See Questions No.12, for Answer.

11. **Explain how adrenaline may be involved in exercise and emergency conditions.**

Ans: See Questions No.11, for Answer.

12. **Enlist the important symptoms and treatments of paralysis and epilepsy.**

Ans: See Questions No.13, for Answer.

INITIATING AND PLANNING

1. Analyze why plants (like sunflower) have a very slow response to stimuli
2. Visualize nervous and hormonal coordination by comparing electrical transmission in wires with the transmission of nerve impulse in neurons and by comparing convection currents in liquids with the hormonal transmission in blood.
3. Compare the BGC (blood glucose concentration) of healthy person with a patient suffering from Diabetes mellitus.

ACTIVITIES

1. Record the difference in quickness of response of the two types of coordination (by asking a student to say a few words in front of the class and observe the change in heartbeat).
2. Perform an experiment in which a scale held at its lower end between the thumb and index finger is allowed to fall and then recording the time taken to catch it again. Identify different parts and draw a labelled diagram of the longitudinal section of the eye of sheep or bull.
3. Perform an experiment in which the shin muscle of a frog is made to contract in a Petri dish filled with methylene blue and using 12 V, DC current.

4 Check the vision of a friend to diagnose whether he/she is suffering from long or shortsightedness.
5 Perform an experiment in which one student flashes a spotlight into the eye of another and record the time taken for the eye to contract its pupil.

SCIENCE, TECHNOLOGY AND SOCIETY

1 Explain the way nervous system helps to coordinate complex and intricate movements of hand to play a piano, or write alphabets.
2 Analyze the way this knowledge has helped humans to train dogs and domesticated animals to perform specific tasks.
3 Explain the reason for salivation of mouth when a favourite food item is imagined.
4. Justify the time difference between seeing the flash of lightening and hearing the roar of a thunderstorm.
5. Explain why and how eyes are important to survival in wild animals.
6. Explain how colour blindness could be a hurdle for aircraft pilots.
7 Conceptualize how scientific advancement has helped to solve the problem of diabetes.
8. Write a paper on, the changes in body while performing an exercise like running a 100 m sprint race.
9. Relate how the knowledge of nervous system has helped humans to treat diseases like epilepsy, paralysis.

ON-LINE LEARNING

1. www.biology-[illegible].org/[illegible]_nervous_system.htm
2. www.[illegible].com/.../biology-nervous-system
3. www.[illegible]edia.bo/education/nervoussystem.htm
4. www.[illegible]imated.com/neuron-animation.htm
5. [illegible].wikipedia.org/wiki/Neuron

TERMS TO KNOW

Acromegaly: Abnormal growth due to excessive production of growth hormone after growth stops, the internal organs and body extremities alone grow large and affected persons have large hands, feet and jawbones.
Antidiuretic hormone: The hormone of the posterior pituitary; promotes the reabsorption of water in renal tubules
Aqueous humour: The fluid present in the anterior chamber of the eye i.e. between the cornea and the iris
Axon: A long, thin fibre that carries nerve impulse away from the cell body of a neuron
Cell body: The part of the nerve cell that contains nucleus
Cerebellum: The part of the hindbrain; controls muscle movements
Cerebral hemispheres: The divisions of the cerebrum of the brain
Cerebrospinal fluid: The fluid in the ventricles of the brain and in the central canal of the spinal cord

Cerebrum: The largest part of the forebrain; controls many sensory and motor functions
Cochlea: The part of the inner ear; consists of three ducts wrapped in the form of a coiled tube; contains sound receptors
Colour blindness: Genetic disorders in which person fails to recognize the basic colours
Cones: The photosensitive cells in the retina of the eye; sensitive to bright light and so distinguish different colours
Cornea: The transparent part of sclera that forms in the front of the eye through which light enters
Cranial nerves: Nerves that arise from or lead to the brain
Dendrites: Short, branched projections of neuron's cell body; transmits nerve impulse towards cell body
Diabetes mellitus: More that normal level of glucose in blood; a condition caused by insufficient concentration of insulin in blood
Dwarfism: Less than normal body growth; a condition caused when growth hormone is insufficient during the growing age
Ear drum: Tympanic membrane; A membrane stretched across the inner end of the auditory canal of the ear
Effectors: The parts of the coordination system that respond when stimulated by nerve impulses or hormones
Endocrine gland: A ductless gland; produces and secretes hormones
Epilepsy: A nervous disorder characterized by recurrent unprovoked seizures (convulsions)
Epinephrine: See Adrenaline
Estrogen: A hormone secreted by the ovaries; promotes development of female secondary sex characteristics and regulates the reproductive cycle
Eustachian tube: The tube between middle ear and the nasal cavity that equalizes the pressure on both sides of the eardrum
Exocrine gland: A gland that discharges its secretion into a duct
Ganglion: The aggregation of the cell bodies of neurons
Grey matter: The nervous tissue containing cell bodies and non myelinated processes of the neurons
Hormone: A substance that is secreted by an endocrine gland directly into blood and that produces a specific effect on a particular tissue
Hypermetropia: The condition in which a person is not able to see near objects clearly; happens when the eyeball shortens and image is formed behind the retina
Hyperthyroidism: The over-production of thyroxin; result in increase in energy production, increased heart-beat, frequent sweating and shivering of hands
Insulin: The hormone produced by the Islets of Langerhans; lowers the blood glucose level
Interneurons: The neurons present in the brain and spinal cord
Iodopsin: A pigment present in the cones of the retina
Iris: A muscular ring formed by the bending of the choroid behind the cornea of the eye
Islets of Langerhans: Groups of endocrine cells present in pancreas;
Medulla oblongata: Part of the hindbrain; on the top of the spinal cord; controls breathing, heart rate, blood pressure and many reflexes

Meninges: Three layers around the brain and the spinal cord; protect them and provide nutrients and oxygen through their capillaries

Mixed nerves: The nerves containing axons of both the sensory and motor neurons

Motor nerves: The nerves which contain the axons of motor neurons only

Myelin sheath: The insulating sheath around the axons of some neurons

Myopia: The condition in which a person is not able to see distant objects clearly; happens due to elongation of the eyeball and image is formed in front

Nerve: The union of several axons that are enveloped by a covering made of lipid

Neuron: Nerve cell; the unit of the nervous system; able to conduct nerve impulses

Nodes of Ranvier: The non-myelinated points between the areas of myelin on the axons of neurons

Optic disc: Blind spot; a point on the retina of the eye where the optic nerve enters the retina; no photosensitive cells exist at this point

Oxytocin: The hormone secreted by the posterior pituitary; stimulates the contraction of uterus walls in females for child birth; necessary for ejection of milk from the breasts

Paralysis: Complete loss of function by one or more muscle groups due to damage in the nervous system

Parathormone: Hormone of the parathyroid glands; increases the level of calcium ions in the blood

Parathyroid: The endocrine glands located on the posterior sides of the thyroid gland; secrete parathormone

Pituitary: The endocrine gland attached to the hypothalamus that controls many other endocrine glands in the body

Pons: Part of the hindbrain; present on top of the medulla; assists the medulla in controlling breathing and serves as a connection between the cerebellum and the spinal cord

Progesterone: A hormone secreted by the ovaries that maintains the uterus during pregnancy

Pupil: The opening in the centre of the iris of the eye

Receptors: The organs/tissues or cells which detect particular type of stimuli

Reflex arc: The nerve pathway over which the nerve impulses travel in a reflex action

Retina: The innermost and the sensitive layer in the eye

Rhodopsin: A pigment present in the rods of the retina

Rods: The photosensitive cells present in the retina of the eye; sensitive to dim light

Schwann cells: The supporting cells around neurons; form the myelin sheath

Sclera: The tough, white outer layer of the eye

Semicircular canals: The three bony canals present posterior to the vestibule in the inner ear

Sensory nerves: The nerves which contain only the axons of sensory neurons

Somatotropin: Growth hormone: A hormone of the anterior pituitary; promotes the growth of the body

Spinal nerves: The nerves which arise from the spinal cord

Suspensory ligament: The ring that attaches the lens of the eye to the ciliary muscles

Testosterone: The male sex hormone secreted by testis; stimulates the development of male reproductive system and the male secondary sex characteristics

Thalamus: The part of the forebrain; serves as a relay centre between various parts of the brain and spinal cord

Thyroid: The endocrine gland located in front of the trachea; secretes hormones thyroxin and calcitonin

Thyroxin: The hormone of the thyroid gland; increases the break down of food and release of energy; also responsible for the growth of body

Tympanum: Tympanic membrane: See Eardrum

Vasopressin: Antidiuretic hormone; the hormones secreted by the posterior pituitary; responsible for the reabsorption of water from renal tubules of the nephron

Vestibule: Part of the inner ear; helps to maintain balance of the body

ADDITIONAL MULTIPLE CHOICE QUESTIONS

1. The elongation of eye ball results in:
(a) Myopia (b) Hypermetropia
(c) Blindness (d) None

2. Ali Ibn-Isa book on study of diseases and surgery of eye is:
(a) Zoology (b) Ophthalmology
(c) Biology (d) None of these

3. The pathway followed by the nerve impulses for producing a reflex action is called:
(a) Reflex action (b) Reflex arc
(c) Neuron (d) Spinal cord

4. A co-ordinated action has:
(a) Three components (b) Four components
(c) Five components (d) Six components

5. Nervous co-ordination and chemical co-ordination are the types are:
(a) Stimulus (b) Receptors
(c) Effectors (d) Co-ordination

6. The organs which are specifically built to detect particular type of stimulus are called:
(a) Receptors (b) Effectors
(c) Stimuli (d) None of these

7. _____ are the duct less glands:
(a) Reflex arc (b) Reflex action
(c) Co-ordination (d) Hormones

8. The structural and functional unit of nervous system is:
(a) Brain (b) Hormone
(c) Effectors (d) Neuron

9. The nervous system consists of billions of neurons and:
(a) Hormones (b) Nephrons
(c) Neuroglial cell (d) None of these

10. Nucleus and cytoplasm of neuron is located in:
(a) Cell body (b) Dendrites
(c) Axons (d) Myelin sheath

11. _____ is a wave of Electrochemical changes that travels along the length of neurons:
(a) Neuron (b) Nerving pulse
(c) Sensory neuron (d) Motor neurons

12. _____ are special neuroglial cells:
(a) Sensory cells (b) Motor cells
(c) Schwann cells (d) None of these

13. The nervous system is divided into the _____ and the _____; the former consists of _____; the latter _____.
(a) ANS; PNS; the nerves around the body; the ventricles
(b) ANS; CNS; the nerves around the body; the brain and spinal cord
(c) CNS; PNS; the nerves around the body; the ventricles
(d) CNS; PNS; the brain and spinal cord; the nerves around the body

14. The brain's supporting cells are called:
(a) Neuroglial cells (b) Mitochondria
(c) Nuclei (d) Neurons

15. Which of the following is not a part of a neuron?
(a) Dendrite (b) Nucleus
(c) Lobe (d) Synaptic cleft

16. The inner layers is sensory called:
(a) Retina (b) Rods
(c) Cones (d) Fovea

17. Abn-Al-Haythams is famous for his book on:
(a) Biology (b) Optics
(c) Motion (d) Chemistry

18. Ear drum is called :
(a) Pinna (b) Auditory canal
(c) Tympanum (d) None of these

19. Convex lens is used to rectify:
(a) Myopia (b) Hypermetropia
(c) Vision (d) Night blindness

20. Concave lens is used to rectify:
(a) Myopia (b) Hypermetropia
(c) Vision (d) Night blindness

21. _____ is not able to see during day time:
(a) Parrot (b) Owl
(c) Rabbit (d) Bat

22. _____ is the smallest bone of the human body :
(a) Malleus (b) Incus
(c) Stapes (d) All

23. Pea-shaped gland attached to the hypothalamus of brain is:
(a) Pituitary gland (b) Somatotrophin
(c) Gigantism (d) Acromegaly

24. _____ seprates the middle ear from inner ear:
(a) Malleus (b) Incus
(c) Stapes (d) Eustachian

25. _____ is present in the centre of ear:
(a) Vestibule (b) Incus
(c) Stapes (d) Eustachian

26. In the figure of the human eye, which of the following labels are correct?
   - (a) "A" is the blind spot
   - (b) "B" is the pupil
   - (c) "C" is the main refractive element
   - (d) "D" is the fovea
   - (e) all of the above

27. A person suffering from short-sightedness has
   - (a) an eye that is too long and needs a convex lens to focus distant objects
   - (b) an eye that is too long and needs a concave lens to focus distant objects
   - (c) an eye that is too short and needs a convex lens to focus near objects
   - (d) an eye that is too short and needs a concave lens to focus near objects

28. Rods and cones
   - (a) have different physical shapes
   - (b) have different distributions across the retina (more cones in foveal region)
   - (c) have different distributions across the retina (more rods in foveal region)
   - (d) a and b

29. The relay station between the retina and the cortex
   - (a) the optic chiasm
   - (b) the visual cortex
   - (c) the superior colliculus
   - (d) the lateral geniculate nucleus of the thalamus

30. The pancreas gland has a duct which opens into the:
   - (a) Duodenum
   - (b) Liver
   - (c) Stomach
   - (d) Large intestine

31. Which of the following carry impulse from brain to effector?
   - (a) Sensory neuron
   - (b) Motor neuron
   - (c) Connecting neuron
   - (d) Mixed nerve

32. Short thread like branches of nerve cell are called
   - (a) dendrites
   - (b) synapse
   - (c) nodes of Ranvier
   - (d) neuron

33. A chemical known as neurotransmitter is released from the ends of :
   - (a) axon
   - (b) synapse;
   - (c) nodes of Ranvier
   - (d) neuron

34. The pituitary gland is found:
   - (a) in the neck
   - (b) at the base of the brain
   - (c) beneath the stomach
   - (d) near the kidneys

35. The transparent window at the front of the eyeball is called
   - (a) cornea
   - (b) iris
   - (c) cone
   - (d) retina

36. Hormones are carried around in the body by:
   - (a) blood
   - (b) nerves
   - (c) lymph
   - (d) both blood and lymph

37. Which of the following glands secretes the hormone thyroxin?
    (a) Pituitary gland (b) Thyroid gland
    (c) Brain (d) Pancreas
38. Which of the following hormones is secreted by the pancreas?
    (a) Growth hormone (b) Thyroxin
    (c) Insulin (d) Prolactin
39. The disease cretinism is caused due to:
    (a) hypoactivity of pituitary gland
    (b) hyperactivity of pituitary gland
    (c) hypoactivity of thyroid gland
    (d) hyperactivity of thyroid gland
40. Hyposecretion of insulin causes:
    (a) Goitre (b) Cretinism
    (c) Diabetes insipidus (d) Diabetes mellitus

ANSWERS

1	a	2	b	3	a	4	c	5	b
6	a	7	d	8	d	9	c	10	a
11	b	12	c	13	d	14	d	15	c
16	a	17	b	18	c	19	b	20	a
21	b	22	c	[illegible]	a	24	d	25	a
26		27	b	28	c	29	b	30	a
31	b	32	[illegible]	33	a	34	b	35	a
36	[illegible]	[illegible]	b	38	c	39	d	40	d

SHORT ANSWERS

Q.1: What is working of Nervous system?
Ans: Nervous system works with the endocrine system to communicate, integrate and coordinate the functions of various organs and systems in our body and responds to the external stimuli.

Q.2: What the division of human nervous system?
Ans: In humans the nervous system has two divisions, the central nervous system and the peripheral nervous system.

Q.3: What is CNS?
Ans: The central nervous system comprises of brain and the spinal cord, while the peripheral nervous system includes the nerves, which connect the central nervous system with sense organs, muscles and the glands in the body.

Q.4: Define Nerve.
Ans: Nerves are thread like structures that emerge from brain and spinal cord and branch out to almost all parts of the body.

Q.5: Define Neuron.
Ans: A neuron is the basic unit of nervous system. There are three types of neurons - sensory neurons, motor neurons and connecting relay or intermediate neurons.

Q.6: What is Synapses?
Ans: A synapse is the junction of the terminal branches of the axon of one neuron with the dendrites or cell body of another neuron. It is the site of transfer of nerve impulse from one neuron to another.

Q.7: Name the various parts of Brain.
Ans: The brain has three parts - cerebrum, cerebellum and medulla oblongata.

Q.8: What is Reflex action?
Ans: A reflex action is a spontaneous, autonomic and mechanical response to a stimulus controlled by the spinal cord without the involvement of the brain.

Q.9: What is reflex Arc?
Ans: The pathway followed by sensory or motor nerves in a reflex action is called reflex arc.

Q.10: Define Sense organs.
Ans: Sense organs are the organs by which you detect changes in the external environment.

Q.11: Name the Senses of Humans.
Ans: The five sense organs are eyes, ears, skin, tongue and nose.

Q.12: How Sense Organs work?
Ans: Messages from the sense organs are carried to the brain by nerves. Brain analysis these messages and as a result the sensations are produced.

Q.12: What is role of Sense Organs?
Ans: Without our sense organs we would know nothing about our environment. Therefore we should take care of them and protect them from injury and disease.

Q.13: Define Nodes of Ranvier.
Ans: Nodes of Ranvier: Regular gaps on the medullary sheath covering the axon.

Q.14: What are Neurotransmitter?
Ans: Neurotransmitter : A chemical released at the synapse which helps in the transmission of nerve impulse from one neuron to another.

Q.15: What is Cerebrum?
Ans: Cerebrum the largest and most prominent part of the brain. It controls intelligence activities, motor activities, etc.

Q.16: Define Cerebellum.
Ans: Cerebellum: The region of the brain under the large cerebrum which controls balance of the body.

Q.17: What is Medulla Oblongata?
Ans: Medulla oblongata : The lowermost part of the brain located at the base of the skull. It controls cardiac and respiratory activities.

Q.18: Define Spinal Cord.
Ans: Spinal cord : A long cord that extends from the medulla oblongata and runs inside the vertebral column.

Q.19: What is Hypermetropia?

Ans: Hypermetropia : The defect of the eye in which the eye can focus the distant objects clearly but the point of focus for an object close to the eye is behind the retina.

Q.20: What is Myopia?

Ans: Myopia : The defect of the eye in which the eye ball is longer than normal, in this defect objects close to the eye can be focused properly but the point of focus for distant objects is in front of the retina.

Q.21: Define Hormone.

Ans: Hormone : A chemical secreted by an endocrine gland and carried by blood or lymph to a target organ elsewhere in the body to stimulate a specific activity.

Q.22: Define Paralysis.

Ans: Paralysis is the complete loss of function by one or more muscle groups. It is most often caused by damage to the central nervous system (brain or spinal cord).

Q.23: Write the causes of Paralysis.

Ans: The damage may be due to stroke (rupture in a blood vessel of brain or spinal cord) blood clotting in these blood vessels, or poison produced by polio viruses.

Q.24: What are Symptoms of Paralysis?

Ans: Patient may have weak paralysis throughout his / her body or have paralysis in one side of body. There may also be paralysis in the lower extremities or in all four limbs.

Q.25: Define Epilepsy.

Ans: Epilepsy is a nervous disorder in which there is abnormal and excessive discharge of nerve impulses in brain. It causes unprovoked seizures in patient.

Q.26: What are convulsions?

Ans: A seizure of epilepsy is a temporary abnormal state of brain marked by convulsions.

Q.27: What are Causes of Epilepsy?

Ans: In younger people, epilepsy may be due to genetic or developmental causes. In people over age 40 years, brain tumours are more likely to cause epilepsy. Head trauma and central nervous system infections may cause epilepsy at any age.

Q.28: How Epilepsy is Cured?

Ans: There is no known cure of epilepsy but medicines can control seizures. Patients of epilepsy have to take medicines daily for the treatment as well as prevention of seizures. These are termed "anticonvulsant" or "antiepileptic" drugs.

Q.29: What are male Sex Hormones?

Ans: Testes secrete hormones e.g. testosterone, which is responsible for the development of male secondary sex characters such as growth of hair on face and coarseness of voice etc.

Q.30: What are female Sex Hormones?

Ans: Ovaries secrete estrogen and progesterone, which are responsible for the development of female secondary characters such as the development of breast etc.

REVIEW QUESTIONS
MULTIPLE CHOICE

1 **Find the ball-and-socket joint.**
- (a) Joint in the finger bones
- (b) Joint of neck and skull bones
- (c) Joint at elbow
- (d) Joint at pelvic girdle and leg bones

2 **All these are the parts of axial skeleton of humans except:**
- (a) Ribs
- (b) Sternum
- (c) Shoulder girdle
- (d) Vertebral column

3 **The disorders in which there is an accumulation of uric acid in joints:**
- (a) Gout
- (b) Rheumatoid arthritis
- (c) Osteoporosis
- (d) Osteo-arthritis

4 **What is correct about tendons?**
- (a) Tendons are flexible and they join muscles with bones
- (b) Tendons are non-elastic and they join bones with bones
- (c) Tendons are non-elastic and they join muscles with bones
- (d) Tendons are flexible and they join muscles with muscles

6 **What are the main components of a bone?**
- (a) Marrow, spongy bone, wax
- (b) Marrow, compact bone, wax
- (c) Compact bone and marrow
- (d) Compact bone, spongy bone, marrow

7 **What do some bones produce?**
- (a) Mucous
- (b) Hormones
- (c) Oxygen
- (d) Blood cells

8 **How would you define skeletal system?**
- (a) All the bones in body.
- (b) All the muscles and tendons.
- (c) All the body's organs, both soft and hard tissues
- (d) All the bones in body and the tissues that connect them.

9 **Find the INCORRECT statement**
- (a) Bone is where most blood cells are made
- (b) Bone serves as a storehouse for various minerals
- (c) Bone is dry and non-living supporting structure
- (d) Bone protects and supports the body and its organs

10 **The purpose of rib cage is to:**
- (a) Protect the stomach
- (b) Protect the spinal Cord
- (c) Protect the heart and lungs
- (d) Provide an object to which the lungs can attach

Answers

1	d	2	c	3	a	4	a	5	b
6	c	7	d	8	d	9	c	10	c

SHORT QUESTIONS

1. Differentiate between cartilage and bone.

Ans: **Cartilage** is a dense, clear blue-white firm connective tissue (but less strong than bone).

Bone is the hardest connective tissue in body. Bones not only move, support and protect the various parts of body but also produce red and white blood cells and store minerals

2. What is the role of skeleton in support and movement?

Ans: Skeleton provides protection to many internal organs e.g. skull protects brain, vertebral column protects spinal cord and ribs protect most of our other internal organs.

3. How would you differentiate between osteoporosis and arthritis?

Ans: **Osteoporosis** is a bone disease in adults, especially in old people. It is more common in old women. In osteoporosis, there is a decrease in the density of bones due to loss of calcium and phosphorus

Arthritis means "inflammation in joints". It is also very common in old age and in women.

UNDERSTANDING THE CONCEPTS

1. What are the main components of the axial skeleton and the appendicular skeleton of human?

Ans: See Question No. 4, for answer.

2. Describe the types of joints and give examples.

Ans: See Question No. 5, for answer.

3. What are ligaments and tendons? What function do they perform?

Ans: See Question No. 5, for answer.

4. Explain antagonism in muscle action selecting biceps and triceps as example.

Ans: See Question No. 6, for answer.

TERMS TO KNOW

Appendicular Skeleton: The division of the skeleton that includes arms, hands, legs, feet pectoral girdle and pelvic girdle.

Arthritis: Terms used for the inflammation in joints.

Axial skeleton: The division of the skeleton that includes the skull, vertebral column, ribs and breastbone.

Ball-and-socket joint: The joint that allows movement in all directions e.g. hip and shoulder joints.

Biceps: A flexor muscle on the front of the upper arm bone.

Bone: Hard connective tissue: moves, supports and protects the various organs of the body.

Cartilage: The connective tissue that makes part of the human skeleton.

Chondrocyte: The cells present in the cartilage.

Compact bone: The hard outer layer of bones.

Cranial bones: The bone of the cranium.

Extensor: A muscle that extends a joint.

Fibrous cartilage: The cartilage that has large number of fibres in the matrix e.g. the cartilage in intervertebral disc.

Flexor: A muscle that bends a joint.

Gout: A type of arthritis; characterised by the accumulation of uric acid crystals in the moveable joints.
Hinge joint: A joint that permits movement of bones in one plane e.g. elbow and knee joints
Hyaline cartilage: The cartilage that has collagen fibres in its matrix; found covering the ends of the long bones, in the nose, larynx, trachea and bronchial tubes.
Insertion: The end of the muscle that is attached with a moveable bone
Joint: The location at which two or more bones make contact
Lacuna: The fluid filled space in bone and cartilage, where their cells are present
Ligament: Strong but flexible connective tissue that joins one bone to bone at the joints
Origin: The end of the muscle that is attached with a immoveable bone.
Osteoarthritis: Inflammation in joints due to degeneration in the cartilage present at the joints or due to decreased lubricant production at the joints.
Osteocyte: The mature bone cells.
Osteoporosis: A bone disease in adults, especially in old age; there is a decrease in the density of bones due to loss of calcium and phosphorus.
Rheumatoid arthritis: Painful inflammation of the membranes at the joints.
Skeleton: The framework of hard, articulated structures that provide physical support, attachment for skeletal muscles, and protection for the bodies of animals.
Spongy bone: The soft and porous interior of the bone, contains blood vessels and bone marrow.
Sternum: The chest bone.
Tendon: Tough connective tissue that attaches muscles to bones
True-breeding: The homozygous individual.

ACTIVITIES

1. Identify and draw labelled diagrams of different bones of the axial and appendicular skeleton from real specimen models or charts
2. Describe the movement of various human joints through observation of models
3. Describe the movement of biceps and triceps through presentation of the movement c your elbow.
4. Investigate the chemical nature of bone (by putting three pieces of rib bone of lamb or goat in water, NaOH and dilute HCl)

Note: All these activities are related to practicals'.
For answers consult "Alif Key Stone" practical notebook .

SCIENCE, TECHNOLOGY AND SOCIETY

1. Relate your skeleton with its functioning in daily life.
2. Relate the principle of leverage to the action of elbow joint.
3. State the principles of arthroplasty for the replacement of joints.

ON-LINE LEARNING

1. www.tutorvista.com/ks/human-biology-(skeleton)
2. [illegible]in.be/e.ducation/biology[illegible]human.htm
3. www.enchantedlearning.com/.../skeleton/Labelskeleton.shtml
4. www.innerbody.com/image/skelfov.html

ADDITIONAL MULTIPLE CHOICE QUESTIONS

1. Which cell changes shape to carry out its normal function?
   (a) Muscle cell (b) Neuron
   (c) Root hair cell (d) Xylem vessel
2. Support in animals may be provided by:
   (a) Skeleton (b) Chemicals
   (c) Nervous system (d) Muscles
3. The need for support became greater as the organism:
   (a) Increase in size (b) Colonized land
   (c) Both (a) (d) Muscles
4. Which of the following shows movement at cellular level?
   (a) Heart beat (b) Movement of root
   (c) Cytoplasmic streaming (d) Live in water
5. Which of the following shows movement at organ level?
   (a) Movement of shoot (b) Motility of gametes
   (c) Cytoplasmic streaming (d) All of these
6. Which of the following plant can locomote?
   (a) Pinus (b) Chlamydomonas
   (c) Strawberry (d) Fern
7. The process of locomotion is used for:
   (a) Finding food by animals (b) Avoiding capture by enemies
   (c) Dispersal of seeds and fruits in plants (d) All of these
8. In plants supporting tissues are abundant in:
   (a) Root (b) Stem
   (c) Leaves (d) Fruit
9. Vascular tissues provide support to young dicot stem by:
   (a) Their cylindrical distribution
   (b) Their dead thick walled tracheids
   (c) Their elongated fibrous cells
   (d) All of these
10. Which one of the following are the supporting tissue of woody dicot stem?
    (a) Bark (b) Collenchymatous tissue
    (c) Wood (d) Both a and c
11. Bark of the tree is formed by:
    (a) Cork (b) Dead epidermis
    (c) Cortex (d) All of these
12. Which substances are need for healthy bones and teeth?
    (a) Calcium and vitamin C (b) Calcium and vitamin D
    (c) Iron and vitamin C (d) Iron and vitamin D
13. Inner bark of the tree is formed by:
    (a) Cortex (b) Phloem
    (c) Cork cambium (d) Both a and b

14. Which of the following help in horizontal transport of food materials in woody dicot stem?
(a) Medullary rays (b) Pith
(c) Cortex (d) Epidermis

15. Locomotion in euglena takes place by:
(a) Cilia (b) Flagella
(c) Pseudopodia (d) None of these

16. In Volvox colony, the movement of cilia in controlled by:
(a) Eye spot in each cell
(b) Long thread like structures present in cytoplasm
(c) Hormones (d) Water currents

17. The skeleton of human body consists of:
(a) 106 bones (b) 206 bones
(c) 306 bones (d) 406 bones

18. A mature xylem vessel in a wood plant has
(a) A cell wall only (b) A cell wall and a vacuole
(c) A cell membrane, cytoplasm and a nucleus
(d) Cytoplasm, a cell wall and nucleus

19. Which of the following structure form central supporting structure of the skeleton?:
(a) Vertebral column (b) Skull
(c) Pelvic girdle (d) Pectoral girdle

20. The vertebral column consists of how many vertebrae?
(a) 23 (b) 43
(c) 33 (d) 53

21. Which of the following muscles help in breathing:
(a) Smooth muscles (b) Diaphragm muscles
(c) Cardiac muscles (d) Skeletal muscles

22. Which of the following fibrous materials attach muscles to the bones?
(a) Ligaments (b) Tendons
(c) Cartilage (d) Glue proteins

23. Which of the following structure connects the relevant bones?
(a) Tendons (b) Glue proteins
(c) Ligaments (d) None of these

24. The ball and socket joints allow movements in how many directions?
(a) Forwards (b) Backwards
(c) Sideways (d) All of these

25. Which of the following muscle lies in front of the humerus?
(a) Triceps muscle (b) Biceps muscle
(c) Smooth muscles (d) Cardiac muscles

ANSWERS

1	a	2	a	3	c	4	c	5	a
6	b	7	d	8	b	9	d	10	d
11	d	12	b	13	d	14	a	15	b
16	a	17	b	18	a	19	a	20	c
21	b	22	b	23	c	24	d	25	b

ADDITIONAL SHORT ANSWERS

Q.1: Define Support.

Ans: The organisms with greater sizes need support to keep their body mass as one unit. This is particularly true for the organisms that live on land.

Q.2: What is Movement?

Ans: The movement and locomotion are characteristics of animals. "Movement" is a general term meaning the act of changing place or position by entire body or by its parts. There are two types of movements

Q.3: Define Hyaline Cartilage.

Ans: Hyaline cartilage is strong yet flexible. It is found covering the ends of the long bones, in the nose, larynx, trachea and bronchial tubes

Q.4: Define Elastic Cartilage.

Ans: Elastic cartilage is similar in structure to hyaline cartilage. It is also quite strong but has elasticity due to a network of elastic fibres in addition to collagen fibres. It is found in epiglottis, pinna etc.

Q.5. Define Fibrous Cartilage.

Ans: Fibrous cartilage is very tough and less flexible due to large number of thick collagen fibres present in knitted form. It is found in intervertebral discs.

Q.6: What is Compact Bone?

Ans: The hard outer layer of a bone is called compact bone.

Q.7: What is Spongy Bone?

Ans: The interior bone is soft and porous its called spongy bone. Spongy are contains blood vessels and bone marrow.

Q.8: Define Osteocytes.

Ans: On the other hand, bones contain different types of cell The mature bone cells are called ostoocytes.

Q.9: What is Axial Skeleton?

Ans: Axial skeleton consists of the 80 bones in the head and trunk of body. It is composed of five parts.

Q.10: Define Appendicular Skeleton.

Ans: Appendicular skeleton is composed of 126 bones. Pectoral (shoulder) girdle is made of 4 bones. Arms have 6 bones. Both hands have 56 bones. Pelvic girdle (hips) has 2 bones. Legs have 8 bones. Both feet have 56 bones.

Q.11: Write the Types of Joints.

Ans: Immoveable (Fixed) joints, Slightly moveable joints

Q.12: What are Moveable joints?

Ans: They allow a variety of movements e.g. shoulder joint, hip Joint, elbow joint, knee joint etc. There are many types of moveable joints in body. The main types are hinge joints and ball-and-socket joints.

Q.13: Define Hinge Joints.

Ans: Hinge joints move back and forth like the hinge on a door and allow movements in one plane only. The knee and elbow are hinge joints.

Q.14: Define Ball-and-Socket.

Ans: Ball-and-socket joints allow movement in all directions. The hip and shoulder joints are ball-and-socket joints.

Q.15: What is the role of Tendon and Ligaments?

Ans: Tendons and ligaments are bands of connective tissue (made of collagen). Tendons are tough bands and attach muscles to bones. When a muscle contracts tendon exerts a exerts force on the attached bone, which moves as a result. Ligaments are strong but flexible bands and join one bone to another at joints. They prevent dislocation of bones and joints.

Q.16: What is Origin?

Ans: One end of a skeletal muscle is always attached with some immoveable bone. This end of muscle is called the origin.

Q.17: Define Insertion.

Ans: Other end of muscle is attached with a moveable bone and is called the insertion. When a muscle is stimulated by a nerve impulse, it contracts to become shorter and thicker. Due to this contraction, it pulls the moveable bone (at insertion).

Q.18: Define Antagonists.

Ans: Skeletal muscles are usually in pairs of antagonists. In an antagonistic pair, both muscles do opposite jobs.

Q.19: What is Antagonism?

Ans: When one muscle contracts the other relaxes and this Phenomenon is known as antagonism (antagonistic action).

Q.20: What are Flexor and Flexion?

Ans: When a muscle contracts and bends the joint, it is known as flexor muscle and the movement is called flexion.

Q.21: Define Extensor and Extension.

Ans: When a muscle contracts and straightens the joint, it is known as extensor muscle and the movement is called extension. ~~Following is an example of the antagonistic action of a Pair of skeletal muscles~~

Q.22: Define Biceps and Triceps.

Ans: Biceps is a flexor muscle on the front of the upper arm bone while Triceps is an extensor muscle on the back of arm. Both these muscle have their origin at pectoral girdle and insertion at one of the two bones of forearm.

Q.23: What is Osteoporosis?

Ans: In old people it is more common in old women. In osteoporosis, there is a decrease in the density of bones due to loss of calcium and phosphorus.

Q.24: What is the cause of Osteoporosis?

Ans: In old age, it may be due to malnutrition (lack of proteins and Vitamin C), lack of physical activities or deficiency of estrogen hormone.

Q.25: Define Arthritis.

Ans: Arthritis means "inflammation in joints". It is also very common in old age and in women.

Q.26: What is Gout?

Ans: It is characterised by the accumulation of uric acid crystals in moveable joints. It generally attacks the toe joints.

REVIEW QUESTIONS
MULTIPLE CHOICE 1

1. **Growing an entire new plant from part of the original plant is called:**
   (a) Budding (b) Regeneration
   (c) Fragmentation (d) Vegetative propagation
2. **Rhizopus reproduces asexually by:**
   (a) Binary fission (b) Budding
   (c) Spore formation (d) Endospore formation
3. **A corm develops into new garlic plant. This is the process of:**
   (a) Vegetative propagation (b) Regeneration
   (c) Meiosis (d) Gametogenesis
4. **Which is NOT an advantage of grafting?**
   (a) The graft is identical to the parent plant
   (b) Grafting allows the propagation of seedless fruits
   (c) The graft combines the characteristics of two plants
   (d) Grafting may allow for the faster production of desirable fruits
5. **Pollination is the transfer of pollens from:**
   (a) Anther to stigma (b) Stigma to anther
   (c) Sepal to petal (d) Petal to sepal
6. **Double fertilization in plants means:**
   (a) Fusion of two sperms with two egg cells
   (b) Fusion of one sperm with egg cell and other sperm with fusion nucleus
   (c) Fusion of two sperms with a single egg cell
   (d) Fusion of tube nucleus with fusion nucleus and sperm with egg cell
7. **After fertilization in plants, the fruit develops from:**
   (a) Ovule wall (b) Ovary wall
   (c) Petals (d) Anther
8. **Which part of the female reproductive system receives egg cells from the ovary?**
   (a) Fallopian tube (b) Uterus
   (c) Vagina (d) Cervix
9. **Inside testes the sperms are produced in:**
   (a) Vas deferens (d) Sperm duct
   (b) Seminiferous tubules (d) Collecting ducts
10. **Which of these cells has haploid number of chromosomes?**
    (a) Spermatogonium (b) Primary spermatocyte
    (c) Secondary spermatocyte (d) All of these

Answers

1	d	2	c	3	a	4	c	5	a
6	b	7	b	8	b	9	c	10	d

SHORT QUESTIONS

1. How are the natural and artificial vegetative propagations the methods of asexual reproduction in plants?

Ans: See Question No. 2 and 4 for answer.

2. Why do gardeners use the methods of cutting and grafting?

Ans: The methods of cutting and grafting are used for the purpose of artificial vegetative propagations.

3. "Parthenogenesis is a type of asexual reproduction". Give comments on this statement

Ans: See Question No. 2 and point number 5 for answer.

4. Outline the life cycle of a flowering plant.

Ans: See Question No. 8, for answer.

5. What structural adaptations will you find in a wind-pollinated flower?

Ans: Structural adaptations in wind-pollinated flower are low weight and wings.

6. Give an introduction of Pakistan's National AIDS Control Program.

Ans: See Question No. 17, for answer.

[illegible] THE CONCEPT

1. What are the different ways by which prokaryotes, protozoans and fungi reproduce asexually?

Ans: See Question No. 5, for answer.

2. Explain the different parts of the plant that help in natural vegetative propagation.

Ans: See Question No. 5, for answer.

3. Explain, how the epigeal and hypogeal germinations are different?

Ans: See Question No. 5, for answer.

4. What conditions are necessary for the germination of seeds?

Ans: See Question No. 5, for answer.

5. Outline the methods of asexual reproduction in animals.

Ans: See Question No. 5, for answer.

6. Write a note on the male and female reproductive systems of rabbit.

Ans: See Question No. 5, for answer.

7. Describe the processes of spermatogenesis and oogenesis.

Ans: See Question No. 5, for answer.

8. Why do we consider that overpopulation is a global problem?

Ans: See Question No. 5, for answer.

UNDERSTANDING CONCEPTS

Acrosome: Cap-like head of sperm cell which helps it in penetrating the egg cell.

Alternation of generations: In plants, the phenomenon in which the sporophyte and gametophyte generations alternate with each other.

Androecium: The male reproductive whorl of the flower, consists of stamens.

Anther: The sac-like structure of a stamen in which pollen grains are produced.

Fission: Division into two; the simplest method of asexual reproduction in prokaryotes and many unicellular eukaryotes

Budding: A type of asexual reproduction in which a bud develops as a small outgrowth on parent's body and forms the new individual

Bulbs: Underground vertical shoots which have modified leaves

Calyx: The outer whorl of flowers, consists of sepals

Carpel: Part of the gynoecium of the flower, consists of stigma, style and ovary.

Cervix: In female reproductive system, the part which separates uterus from the vagina

Cloning: Method of asexual reproduction in which identical offsprings are produced from a vegetative tissue or cell of the parent

Corm: Short, swollen underground stem, has bud(s) at the top, gives rise to new plants by vegetative propagation

Corolla: The second whorl of flower, consisting of petals

Cotyledon: A modified leaf present in seeds, often gives nourishment to the developing seedling

Cowper's gland: An accessory gland in rabbits male reproductive system, provides lubrication to the ducts

Endosperm nucleus: In the female gametophyte, the triploid nucleus formed by the fusion of sperm and the fusion nucleus.

Endosperm tissue: The tissues that develops from endosperm nucleus, often serves as a food supply for developing embryo

Endospore: The spore formed inside the bacterial cell

Epicotyl: The embryonic stem above the point of attachment of the cotyledon(s)

Epididymis: A storage area for sperms on the upper part of the testes.

Epigeal germination: A type of seed germination in which the hypocotyl elongates and forms a hook, pulling the cotyledons above the ground

Fallopian tube: a part of the female reproductive system, receives egg cell discharged from the ovary

Follicle: A structure in the ovary in which the mature egg develops

Fragmentation: A type of asexual

Fusion nucleus: A part of the female gametophyte in plants, formed by the fusion of two nuclei, gives rise to endosperm nucleus when fertilized by a sperm

Gametogenesis: The process of the formation of gametes.

Sporophyte/Gametophyte: The haploid generation in plant life cycle, produces gametes.

Grafting: A type of artificial vegetative propagation in which a piece of stem is cut from the plant and is attached into another plant with established root system

Gynoecium: The central whorl in the flower, consists of carpels

Hilum: A scar on the seed coat, the point where the seed is attached to the ovary wall

Hypocotyl: The embryonic stem below the point of attachment of cotyledon

Hypogeal germination: A type of seed germination in which the epicotyl elongates and forms the hook while the cotyledons stay underground.

Macrospore: Haploid cell produced in the ovule, divides mitotically and produces the female gametophyte

Micropyle: The opening in the ovule through which the pollen tube enters; seed uses it for the absorption of water.

Microspores: Pollen grain; the haploid cells produced in the pollen sac; divide mitotically to produce male gametophyte.

Multiple fission: Division into many; a method of asexual reproduction used by many unicellular organisms.

Oogenesis: The formation of ovum (egg cell).

Oogonium: (*Plural* Oogonia): The diploid cells in the follicles of the ovary; produce diploid primary oocytes during Oogenesis.

Ovary: The female gonad; produces egg cells and female sex hormones.

Ovule: In seed plants, a structure present in the ovary; contains macrospore that develops into female gametophyte; ovule develops into seed after fertilization.

Parthenocarpy: The process in which ovaries develop into fruit without the fertilization in the ovules present in them; results in seedless fruits e.g. bananas.

Parthenogenesis: A form of asexual reproduction in which an unfertilized egg develops into new offspring.

Plumule: The part of the plant embryo that develops into new shoot.

Pollen grain: See Microspore.

Pollen tube: A tube formed by the tube nucleus of the pollen grain; carries sperms to the ovule.

Pollination: The transfer of pollen grains . from flower's anther to stigma.

Prostate gland: An accessory gland in the male reproductive system; produces a secretion that neutralizes the acidity.

Radicle: The part of the plant embryo that develops into new root

Rhizomes: Horizontal underground stems; have scale leaves with buds; shoots of the new plant develop and grow form buds (vegetative propagation).

Seed dormancy: A period, during which there is no growth in the seed seeds in dormancy are ripe seeds but do not germinate; under favourable conditions, the seeds break dormancy and begin to germinate.

Semen: The material containing sperms in a fluid.

Seminal vesicle: The associated gland in male reproductive system; produces secretions having nutrients for the sperms

Seminiferous tubule: The coiled tubes present in testes; sperms are formed in these tubules.

Sperm: The male gamete.

Spermatids: The immature non-motile forms of sperms; are converted into sperms after many changes.

Spermatogenesis: The formation of sperms.

Spermatogonium: The diploid cells in semineferous tubules of the testes; divide mitotically and produce primary spermatocytes.

Sporophyte: The diploid generation in plant life cycle; produces spores.

Stamen: The part of the androecium; consists of anther and filament.

Stigma: The upper part of the carpel.

Style: The middle portion of the carpel.

Testa: See Seed coat.
Testis: The male gonads; produces sperms and male sex hormones
Tubers: The swollen ends of slender rhizomes (underground stem); new plants develop from buds on the stem tubers (vegetative propagation).
Uterus horn: The two separate parts of the uterus in the female rabbit
Vas deferens: The tubes that carry sperms from each testis to the urethra
Vegetative propagation: A type of asexual reproduction in which the vegetative parts of the plants i.e. roots, stems or leaves produce new generation

ACTIVITIES

1. Identify different stages of budding in the prepared slides of yeast and draw diagrams
2. Examine the specimens of onion, corn, ginger and potato and write the mode of their reproduction and describe their cultivation to get new plants
3. Identify different parts of flower
4. Identify and draw the component of the seeds of pea or gram.
5. Perform experiment to investigate the necessary conditions for seed germination.
6. Draw different stages of binary fission in amoeba after observing them through slides or charts

Note: All these activities are related to practicals'.
For answers consult "Alif Key Stone" practical notebook .

SCIENCE, TECHNOLOGY AND SOCIETY

1. Grow plants at home using asexual reproduction methods.
2. Describe commercially important applications of asexual reproduction in plants
3. Justify cloning as a form of asexual reproduction
4. State the advantages and disadvantages of having large families.
5. Debate the social implications of AIDS and other sexually transmitted diseases.

ON-LINE LEARNING

1. http://[illegible]omain org resource tdc02 sci life.repro.lp_reproduce/
2. www.[illegible]education biology animationshuman.htm
3. www.[illegible]ces.com en a442 plant-life cycle
4. www.[illegible]/image skelfox html

ADDITIONAL MULTIPLE CHOICE QUESTIONS

1. **Which region [illegible] coordination?**
   - (a) Cerebellum
   - (b) Cerebrum
   - (c) Hypothalamus
   - (d) Medulla
2. **What is controlled by medulla oblongata in the brain?**
   - (a) Balance
   - (b) Memory
   - (c) Breathing
   - (d) Vision
3. **Which part of the brain detects temperature changed in the blood?**
   - (a) Cerebral hemisphere
   - (b) Cerebellum
   - (c) Hypothalamus
   - (d) Medulla
4. **The types of neurons are:**
   - (a) 2
   - (b) 3
   - (c) 4
   - (d) 5
5. **Where are hormones destroyed?**
   - (a) Adrenal gland
   - (b) Kidneys
   - (c) Liver
   - (d) Pancreas
6. **The forebrain is most advance in:**
   - (a) Chimpanzee
   - (b) Dolphin
   - (c) Man
   - (d) Cow
7. **At which level the spinal cord [illegible] reflex centre:**
   - (a) At lower level
   - (b) At middle region
   - (c) At anterior region
   - (d) At any level
8. **Which types of cell stimulates the release of adrenaline?**
   - (a) Motor nerve cell
   - (b) Muscle cell
   - (c) Pancreatic cell
   - (d) Red blood cell
9. **The parasympathetic and sympathetic nerves constitute:**
   - (a) Autonomic nervous system
   - (b) Central nervous system
   - (c) Cranial nervous system
   - (d) All of these
10. **Which of the following nervous pathway operates automatically without following the directions from brain:**
    - (a) Reflex arc
    - (b) Cranial nerves
    - (c) Both a and b
    - (d) Mixed nerves
11. **During the process of focusing of eye the lens undergoes changes in:**
    - (a) Convexity
    - (b) Concavity
    - (c) Direction
    - (d) None of these
12. **Which of the following is the defect of aqueous humour?**
    - (a) Colour blindness
    - (b) Cataract
    - (c) Night blindness
    - (d) All of these

13. The space around the membranous labyrinth contains a fluid called:
    (a) Endolymph (b) Lymph
    (c) Perilymph (d) None of these
14. The sound vibrations are sent from cochlea to brain via:
    (a) Optic nerve (b) Auditory nerve
    (c) Oculomotor nerve (d) Abducent nerve
15. The puncturing of ear drum due to injury or infection may cause:
    (a) Deafness (b) Dizziness
    (c) Loss of balance (d) All of these
16. There are ______ kinds of taste buds:
    (a) Three (b) Four (c) Five (d) Six
17. Which of the following is exocrine as well as endocrine gland
    (a) Thyroid gland (b) Adrenal gland
    (c) Pancreas (d) Glands
18. The hormone calcitonin is secreted by
    (a) Pituitary gland (b) Thyroid gland
    (c) Parathyroid gland (d) Adrenal gland
19. The dorsal roots of spinal nerves contain the fibres of
    (a) Sensory neurons only
    (b) Motor neurons and relay neurons
    (c) Motor neurons and sensory neurons
    (d) Relay neurons and sensory neurons
20. Which substance are [illegible] drugs?
    (a) Alcohol and aspirin (b) Alcohol and heroin
    (c) Alcohol and nicotine (d) Heroin and penicillin
21. Which of the following glands produce male sex cells and androgens
    (a) Testes (b) Ovaries
    (c) Adrenal glands (d) Pancreas
22. The oestrogen hormone is produced by which gland?
    (a) Testes (b) Ovaries
    (c) Pancreas (d) Thyroid
23. The partial or complete loss of the power of motion or sensation in some parts or all the body is called
    (a) Neurosis (b) Paralysis
    (c) Fovea (d) Depression
24. The hormones which activate phototropism and geotropism are
    (a) Gibberellines (b) Cytokines
    (c) Abscissic acid (d) Auxins

25. **Which of the following pair of growth regulators have found to be useful in developing tissue culture?**
    (a) Auxins and cytokinins (b) Gibberellins and cytokinins
    (c) Auxins and gibberellins (d) None of these

ANSWERS

1	a	2	c	3	c	4	c	5	c
6	c	7	d	8	a	9	d	10	a
11	a	12	b	13	c	14	a	15	d
16	b	17	c	18	b	19	a	20	[illegible]
21	a	22	b	23	b	24	d	25	a

ADDITIONAL SHORT ANSWERS

Q.1: What is Reproduction?
Ans: Reproduction is defined as the production of individuals of the same species i.e. the next generation of species.

Q.2: Find Fundamental Characteristics.
Ans: It is one of the fundamental characteristics of living things. It is not an essential life process.

Q.3: Define Continuation of Species?
Ans: Reproduction is thus essential for the continuation of species. It ensures that the genetic material of one generation is transmitted to the next.

Q.4: Define Production of Offsprings.
Ans: Each generation produces more offsprings for the next generation. Many individuals die due to various reasons like diseases, competition, genetic factors etc. before reaching the reproductive age.

Q.5: What is Advantageous?
Ans: Only the fittest and the best survive and reach the reproductive age. This ensures that the advantageous characteristics are transmitted to the next generation.

Q.6: Write the Types of Reproduction.
Ans: There are two types of Reproduction
(i) Asexual reproduction
(ii) Sexual reproduction

Q.7: Types of Asexual Reproduction?
Ans: There are many types of asexual reproduction, all producing individuals that are genetically identical to each other and to the parent.

Q.8: Define Binary Fission.
Ans: Binary fission means "division into two". It is the simplest and most common method of asexual reproduction. It occurs in prokaryotes (bacteria), many unicellular eukaryotes e.g. protozoa and some invertebrates.

Q.9 Define Binary Fission in Bacteria.

Ans. During binary fission in bacteria, the DNA is duplicated and so two copies of DNA are formed.

Q.10 Define Binary Fission in Unicellular Eukaryotes.

Ans: During binary fission in unicellular eukaryotes, the nucleus of parent organism divides into two (by mitosis). It is followed by the division of cytoplasm

Q.11 What is Fragmentation?

Ans. As certain worms grow to full size, they spontaneously break up into 8 or 9 pieces. Each piece (fragment) develops into a mature worm, and the process is repeated.

Q.12: Define Budding.

Ans. In this type of asexual reproduction, a bud develops as a small outgrowth on parent's body. In case of yeast (a unicellular fungus) a small bud is formed on one side of cell.

Q.13 Define Budding in Hydra.

Ans. Animals such as sponges, *Hydra* and corals also reproduce by means of budding. In them, a small bud is formed on the side of body, by mitosis. This bud enlarges by the formation of more cells. It then detaches from the parent body and grows into new organism

Q.14 What is Spore Formation?

Ans. It is generally seen in most fungi (e.g. *Rhizopus*). When *Rhizopus* reaches reproductive age, its body cells form thick walled round structures called sporangia (*single*, sporangium)

Q.15 Define Spore

Ans. Inside each sporangium, a cell divides many times and forms many daughter cells called spores

Q.16 What is Cyst?

Ans. Each spore is covered with a thick wall called cyst and it can survive unfavourable conditions. When sporangia are mature, they burst and release spores

Q.17 What is Endospores?

Ans. Under unfavourable conditions, some species of bacteria reproduce by forming spores, e.g. *Clostridium* and *Bacillus* species

Q.18: Define Parthenogenesis

Ans: Parthenogenesis is also considered as a form of asexual reproduction. In it, an unfertilized egg develops into new offspring. Some fishes, frogs and insects reproduce by means of parthenogenesis.

Q.19: What is Vegetative Propagation

Ans. When vegetative parts of plants i.e. roots, stems or leaves give rise to new plants, the process is called vegetative reproduction or vegetative propagation

Q.20: Define Bulbs.

Ans. Bulbs are short underground stems surrounded by thick, fleshy leaves that contain stored food. Adventitious roots emerge under the base of bulb while shoots emerge from the top of the base. Tulips, onions and lilies reproduce by bulbs.

Q.21: Define Corms

Ans. Corms are short and swollen underground stems containing stored food. Buds are present at the top of corm. From a bud, shoot grows and forms a new plant. Dasheen and garlic reproduce by corms.

Q.22: What is Rhizomes.

Ans: Rhizomes are horizontal underground stems with scale leaves. There are enlarged portions called nodes on rhizome.

Q.23: What is Stem Tubers?

Ans: Stem Tubers are the enlarged portions of an underground stem (rhizome). There are aggregations of tiny buds in the form of "eyes" along the surface of tuber.

Q.24: Define Suckers.

Ans: Suckers are lateral stems close to ground level. A sucker grows underground for some distance and then turns up, producing the new plant

Q.25: Define Vegetative Propagation by leaves.

Ans: Vegetative propagation by leaves is not common and is seen in plants such as Bryophyllum (Pather chut)

Q.26: What is Sporophytic Generation?

Ans: In the life cycle of plants, two different generations alternate with each other.

Q.27: Define Gametophtic Generation.

Ans: One generation is diploid and produces spores. It is called sporophyte generation The other generation is haploid and produces gametes It is called gametophyte generation

Q.28: What is Alternation of Generation?

Ans: The phenomenon in which two different generations alternate with each other during life cycle is known as alternation of generations

Q.29: Write Types of Pollination.

Ans: Two types of pollination are recognized

(i) Self pollination

(ii) Cross pollination

Q.30: Define Seed Coat.

Ans: Seed coat (or testa) develops from the integument, originally surrounding the ovule. It may be a paper-thin layer (e.g. peanut) or thick and hard (e.g coconut). Seed coat protects embryo from mechanical injury and from drying out.

Q.31: What is Gametogenesis?

Ans: The formation of gametes is called gametogenesis. In this process, diploid (2N) gamete-mother cells undergo meiosis and form haploid (1N) gametes. The male and female gametes (sperms and egg cells or ova) are produced in specialized organs called gonads.

Q.32: What is Testis?

Ans: Male gonads are called testes (*Singular,* testis).

Q.33: Define Ovaries.

Ans: While female gonads are called ovaries. The production of sperms in testes is called spermatogenesis and the production of egg cells in ovaries is called oogenesis

Q.34: What is Fertilization?

Ans: Fusion of Male and Female Gametes which produces zygote is called fertilization.

Q.35: Define Scrotum.

Ans: Testes are located in a bag of skin called the scrotum that hangs below the body.

Q.36: What is Female Reproductive System?

Ans: The female reproductive system of rabbit consists of ovaries and associated ducts.

Q.37: What is Ovaries?

Ans: Ovaries are small oval organs situated in abdominal cavity just ventral to kidneys. Like most animals, female rabbits have a pair of ovaries. The outer region of ovary produces egg cells.

Q.38 Define Follicle.

Ans: A cluster of specialized cells called follicle surrounds and nourishes each egg cell. From ovaries, egg cells are released in fallopian tubes.

Q.39. What is HIV?

Ans: It is also a sexually transmitted disease. AIDS stands for Acquired Immuno Deficiency Syndrome

Q.40 What are the Causes of AIDS?

Ans: Thus the main causes are unprotected sexual activities, use of infected needles or transfusion of infected blood

Q.41: What is the Role of Government?

Ans: According to the latest data by the World Bank, at least 54 NGOs are working in Pakistan for HIV AIDS public awareness and for the care and support of persons living with HIV AIDS

2. Prepare a report using newspaper clippings on the recent advances and future possibilities in genetics.
3. Rationalize life as a product of the diversity brought about by chromosomes genes and DNA.
4. Outline the scientific findings and some of the technological advances that led to the modern concept of gene.
5. Analyses the concept of gene to produce various proteins of the body.
6. Describe the importance of scientific investigation and mathematical know how in genetics.
7. Explain how genetics can predict the progeny of two individuals which are crossed.
8. What is the role of environment on the selection of better variations?

ON-LINE LEARNING

1. en.wikipedia.org/wiki/Punnett_square
2. www.uic.edu/classes/bios/biosl01/genesl
3. www.human-nature.com/darwin/
4. en.mimi.hu > Biology

Allele: The alternative form of a gene.

Artificial selection: Selective breeding, intentional breeding between individuals for certain traits, or combination of traits.

Breeds: The animals which are bred through artificial selection.

Chromatin: The chemical material that make the structure of the chromosome.

Co-dominance: The situation where two allele of a gene pair express their traits independently instead of showing a dominant-recessive relationship.

Cultivars: The plants which are bred through artificial selection.

Dihybrid cross: A genetic cross in which two pairs of contrasting traits are studied.

Dominant trait: The trait that appears in the offspring of a cross between two homozygous individuals showing contrasting forms of the trait.

Gene: Unit of inheritance; consists of the length of DNA that contains specific instructions for the synthesis of a protein molecule.

Genotype: The specific combination of genes in an individual; may be homozygous or heterozygous.

Heterozygous: The genotype that has two different alleles of a trait.

Histone: The protein present in the structure of chromosome.

Homologous chromosomes: A pair of chromosomes having the same size and shape and carrying alleles for the same traits

Homozygous: Having two identical alleles of a trait.

Incomplete dominance: A type of inheritance in which neither of the pair of contrasting alleles is dominant over the other and the heterozygous individual is intermediate in

phenotype.

Inheritance: The transmission of characteristics from parents to offspring.

Locus: Plural Loci; The locations or positions of genes on chromosomes.

Monohybrid cross: A genetic cross in which only one pair of contrasting traits is studied.

Mutation: Change in chromosome or DNA (gene); produces variations in the traits.

Natural selection: The process in which organisms with favourable variations survive and produce more offspring than less well-adapted organisms.

Nucleosome: The structure formed by the wrapping of DNA around histone proteins.

Organic evolution: Biological evolution: The modification of characteristics in the species or populations of organisms during their descent, generation by generation.

Phenotype: The expression of the genotype in the form of trait.

Recessive trait: The trait which is masked in the offspring of a cross between two homozygous individuals showing contrasting forms of the trait.

Trait: The characteristics which are controlled and transmitted to next generations through genes.

True-breeding: The homozygous individual.

Variation: A characteristic in an individual that differs from the typical characteristics of other individuals of the same species.

ADDITIONAL MULTIPLE CHOICE QUESTIONS

1. The branch of biology which deals with the study of inheritance is know as:

(a) Genetics (b) Embryology
(c) Planetology (d) Genetic Engineering

2. Who solved the problems of heredity for the first time?

(a) Spemann (b) Gregor Mendel
(c) Flemming (d) A. F. A. King

3. Mendel's hereditary factors have now been given the name of:

(a) Nucleotides (b) Elements
(c) Genes (d) Chromosomes

4. The Pisum sativum is the botanical:

(a) Man (b) Wheat
(c) Pea (d) Sheep

5. How many number of contrasting pair characters where chosen by the Mendel for his work on genetics?

(a) 5 (b) 7
(c) 9 (d) 11

6. Organisms which always produces offspring identical to the parent are called _____:

(a) True Breeding (b) False Breeding
(c) Heterozygous (d) None of the above

7. The characters of traits which make their appearance in F1 generation are known as_____:

(a) Dominant (b) Recessive
(c) Intermediate (d) Genotype

8. The trait that is marked in the offspring of a cross between two pure individuals showing contrasting forms of the trait is known as_______:

(a) Dominant (b) Recessive
(c) Phenotype (d) Traits

9. In genetical terms Mendel's factors which determine a given trait, such as stem height, are called:

(a) Genes (b) Alleles
(c) Phenotype (d) Traits

10. The alternative forms of a given genes, such as tall versus dwarf character are called:

(a) Alleles (b) Dominant alleles
(c) Genes (d) Recessive alleles

11. A distinct unit of heredity material found in chromosomes; a sequence of nucleotides in DNA that codes for particular tRNA, tRNA or polypeptide is called____:

(a) Gene (b) Allele
(c) DNA (d) mRNA

12. The total of all the alleles in a population is called:

(a) Genetic Drift (b) Allelomorphs
(c) Gene pool (d) Genotype

13. A sudden heritable change is called:

(a) Crossing over (b) Genetic recombination
(c) Mutation (d) None of these

14. Darwin observed different animals and birds at:

(a) Indian archao palego (b) France
(c) America (d) Galapagos Islands

15. Wings of birds, bats, cockroach and fly are____organs:

(a) Vestigial (b) Homologous
(c) Analogous (d) All of the above

16. The name of Darwin's book, in which he proposed his theory, is:

(a) The origin of species by means of mutation.
(b) The origin of species by means of acquired characteristics.
(c) The origin of species by means of disasters.
(d) The origin of species by means of natural selection.

17. **Evidences of evolution can be obtained through:**
    - (a) Biogeography (b) Geology
    - (c) Comparative anatomy (d) All of these
18. **Example of a vestigial organs is:**
    - (a) Tail of bird (b) Pinna of ear
    - (c) Backbone (d) Appendix

19. **Example of continuous variations is:**
    - (a) Blood groups (b) Attached or free ear lobes
    - (c) Intelligence (d) None of these
20. **Example of discontinuous variations is:**
    - (a) Tongue rolling (b) Weight
    - (c) Height (d) Intelligence

ANSWERS

1	[illegible]	2	b	3	c	4	c	5	b
6	a	7	a	8	d	9	c	10	a
11	a	12	c	13	c	14	d	15	c
16	d	17	c	18	d	19	c	20	a

ADDITIONLA SHORT QUESTION

Q.1: Define Genetics.

Ans: Genetics is the branch of biology in which we study inheritance.

Q.2: Define Inheritance.

Ans: Inheritance means the transmission of characteristics from parents to offspring.

Q.3: What is Traits?

Ans: The characteristics of organisms called the traits.

Example: In man height, colour of the eyes, intelligence etc. are all inheritable traits

Q.4: Define Gene.

Ans: The chromosomes carry the units of inheritance called the genes.

Q.5: Define Homologous Chromosome.

Ans: The body cells have a constant number of paired chromosomes. The two chromosomes of a pair are known as homologous chromosomes. In humans body cells, there are 23 pairs of homologous chromosomes for a total of 46 chromosomes.

Q.6: What is Chromatin?

Ans: Chromosome is made of chromatin material (simply as chromatin). Chromatin is a complex material, made of DNA and proteins (mainly histone proteins).

Q.7: Define Nucleosomes.

Ans: DNA wraps around histone proteins and forms round structures, called nucleosomes. DNA is also present between nucleosomes.

Q.8: What is Transcription?

Ans: DNA controls this sequence of amino acids by the sequence of its nucleotides. During protein synthesis, the sequence of DNA nucleotides decides that what will be the sequence of amino acids.

Q.9: What is Translation?
Ans: The mRNA carries the sequence of its nucleotides to ribosome. The ribosome reads this sequence and joins specific amino acids, according to it, to form protein. This step is known as translation.
Q.10: Define Loci.
Ans: Like chromosomes, genes also occur in pairs, one on each homologous chromosome. The locations or positions of genes on chromosomes are known as loci (*Singular*, locus).
Q.11: What is Homozygous Genotype?
Ans: The genotype in which the gene pair contains two identical alleles (**AA or aa**), is called homozygous genotype.
Q.12: Define Heterozygous Genotype.
Ans: The genotype in which the gene pair contains two different alleles (Aa), is called heterozygous genotype.
Q.13: Define Dominant Allele:
Ans: When in the heterozygous condition one allele masks or prevents the expression of the other, it is called the dominant allele.
Q.15: Who was Mendel?
Ans: Gregor Mendel was a monk (priest) in Austria. He developed the fundamental principles of genetics. Mendel proposed that there are "special factors" in organisms, which control the expression of traits and their transmission to next generations. These factors were eventually termed genes.
Q.16: Define Co-dominance.
Ans: Co-dominance is the situation where two different alleles of a gene pair express themselves completely, instead of showing a dominant-recessive relationship. As a result, the heterozygous organism shows a phenotype that is different from both homozygous parents.
Q.17: What is In-complete dominance?
Ans: In-complete dominance is the situation where, in heterozygous genotypes, both the alleles express as a blend (mixture) and neither allele is dominant over the other.
Q.18: Define Discontinuous Variations.
Ans: Discontinuous variations show distinct phenotypes. The phenotypes of such variations cannot be measured.
Q.19: What is Continuous Variations?
Ans: In continuous variations, the phenotypes show a complete range of measurements from one extreme to the other. Height, weight, feet size, intelligence etc. are example of continuous variations.
Q.20: What is Organic Evolution?
Ans: Organic evolution (biological evolution) is the change in the characteristics of a population or species of organisms over the course of generations. The evolutionary changes are always inheritable. The changes in an individual are not considered as evolution, because evolution refers to populations and not to individuals.

CHAPTER # 16 MAN AND HIS ENVIRONMENT

Q1. Define environment?

Ans: Environment:

The sum total of physical (abiotic) and biotic conditions which influence the organism

Every organism has its specific surrounding or environment with which it continuously interacts and remains fully adapted An organism's environment is the sum of physical (abiotic) and biological (biotic) conditions which influence that organism

Q2. Define Ecology.

Ans: Ecology:

The study of the interrelationship between organisms and their environment is called ecology.

Q3. What are the different levels of ecological organization?

Ans: See Q # 1 from Exercise (Short Questions).

Recalling

A species is a group of organisms which can interbreed freely in nature, to produce fertile offspring

Q4. Define ecosystem and its components.

Ans: See Q # 2 from Exercise (Short Questions).

Q5. Explain how biotic components are further classified?

Ans: Classification of Biotic Components:

i. Producers:

The producers are the autotrophs present in an ecosystem Producers include plants, algae and photosynthetic bacteria. These organisms are able to synthesize complex organic compounds (food) from inorganic raw materials Producers form the basis of any ecosystem

In terrestrial ecosystems, plants are the main producers In aquatic ecosystems, the main producers are the floating photosynthetic organisms (mainly algae) called phytoplankton and shallow water rooted plants.

ii. Consumers:

The consumers are heterotrophs They cannot synthesize their food and so depend upon producers for food. Consumers include all animals, fungi, protozoans and many of the bacteria The animals are the major consumers of ecosystems

Classification of Consumers:

They are further classified as herbivores and carnivores

a. Primary Consumers (Herbivores):

Herbivores e.g. cattle, deer, rabbit, grasshopper etc' feed on plants. They are the primary consumers. They feed directly on plants or products of plants.

b. Secondary Consumers (Carnivores):

Carnivores feed on other animals. Primary carnivores (secondary consumers) feed on herbivores. Fox, frog, predatory birds, many fishes and snakes etc. are primary carnivores.

c. Tertiary Consumers (Secondary carnivores):

Secondary carnivores (tertiary consumers) feed on primary carnivores. Wolf and owl etc. are secondary carnivores. Tertiary carnivores e.g. lion, tiger etc. feed on secondary carnivores.

iii. Decomposers or reducers:

Decomposers or reducers break down the complex organic compounds of dead matter (of plants and animals) into simple compounds. They secrete digestive enzymes into dead and decaying plant and animal remains to digest the organic material. After digestion, decomposers absorb the products for their own use. The remaining substances are added to environment. Many types of bacteria and fungi are the principal decomposers of biosphere.

Q6. Write note on biosphere.

Ans: Biosphere:

The last level of ecological organization, all the ecosystems of the world together form the biosphere.

All ecosystems of the world together form the biosphere. It includes all the ecosystems of the planet Earth. In other words, the biosphere consists of all organisms present on the Earth and all regions of the Earth where they live. Biosphere ranges from the floor of oceans to the tops of the highest mountains. It is about 20 kilometres thick.

Note:

The biosphere makes a thin layer surrounding the planet Earth. If you consider the Earth as of the size of an apple, then the biosphere will be as thick as the apple's skin.

Recalling

Omnivores are the consumers that eat animal flesh as well as plants and plant products.

Examples of omnivores:

Bears, Coatis, Hedgehogs, Opossums, Pigs, Humans, Mice, Rats and Squirrels.
Various birds (whose prey can consist of berries and nectar to insects, worms, fish, small rodents and snakes) etc.

Tertiary carnivores/ top carnivores:

Tertiary carnivores are not eaten by any other animals. They are also called top carnivores.

The minerals, which are released by decomposers, are used as nutrients by the producers.

Q7. How the flow of energy is different from that of materials?

Ans: See Q # 3 from Exercise (Short Questions)

Q8. Explain flow of energy in an ecosystem.

Ans: Flow of Energy in Ecosystem:

The flow of energy in different trophic levels of ecosystem is unidirectional. The following is an overview of the flow of energy in an ecosystem

Energy flow in an ecosystem

Sun is the primary source of energy:

The Sun is the primary source of energy for all ecosystems. Producers get solar energy and transform it into chemical energy by the process of photosynthesis. They store this energy in their tissues and also transform it into mechanical and heat energy during their metabolic activities.

Flow of energy in producers:

The energy in producers' tissues flows to herbivores when producers are eaten. Herbivores transform it into mechanical and heat energy during their metabolic activities and store the rest in their tissues. Carnivores eat herbivores and get energy. They also use it for their body activities and store the rest in their tissues. After the death of producers and consumers, the energy stored in their tissues is used by decomposers.

Law of Thermodynamics:

The storage and expenditure of energy in an ecosystem is in accordance with the basic law of thermodynamics i.e. 'energy can neither be created nor destroyed but can be transformed from one form into another'

Note: In an ecosystem there is,

i. Constant flow or transfer of energy from the Sun through producers to consumers and decomposers

ii. A significant decrease in useful energy during transfer of energy at each trophic level

Q9. Explain flow of materials in an ecosystem.

Ans: Flow of Materials:

The materials flow from one trophic level to the next by means of food chains and food webs

A food chain is a series of organisms within an ecosystem in which each organism feeds on the one before it and is fed by the one after it. For example following is a food chain in an ecosystem

A simple food chain

The base of food chain is always formed by a plant (producer). It is eaten by a primary consumer which is preyed upon by a secondary consumer. The secondary consumer may be eaten by a tertiary consumer.

A food chain, can therefore be represented as

Producer → Primary Consumer → Secondary Consumer → Tertiary Consumer

A food chain involves a nutritive interaction among the biotic components of an ecosystem. Usually there are 4 or 5 trophic levels. Shorter food chains provide greater available energy and vice-versa.

Food web:

In nature, food chains are very complex as one organism may be the food source of many other organisms. Thus, instead of a simple linear food chain, there is a web-like structure formed by these interlinked food chains. Such interconnected food chains collectively make "food web". Food web can be defined as, "a network of food chains which are interconnected at various trophic levels.

A food web in grassland ecosystem

Q10. How would you describe the ecological pyramids?

Ans: Ecological pyramids:

In 1927, Charles Elton (an English ecologist) developed the concept of ecological pyramids. He noted that the animals present at the beginning of food chain are abundant in number while the animals present at the end of food chain are fewer in number. Ecological pyramid can be defined as, "A representation of the number of individuals or amount of biomass or energy present in various trophic levels of a food chain"

Types of Ecological pyramids:

Ecological pyramids are of three types

i. Pyramid of Numbers ii. Pyramid of Biomass

iii. The Pyramid of Energy

Q11. Explain what do you mean by the pyramids of number and biomass.

Ans: See Q # 1 from Exercise (Understanding the Concept).

Q12. Define "Biomass"?

Ans: The total amount of living or organic matter in an ecosystem at any time is called "biomass"

Q13. How would you describe biogeochemical cycles?

Ans: Biogeochemical Cycles:

Biogeochemical cycles are the cyclic pathways through which materials move from environment to organisms and back to environment

Environment is the source of materials for all living organisms. Environment provides bioelements which are used by organisms for their bodies and metabolism. The materials are continuously recycled between organisms and environment

Carbon cycle:

The biogeochemical cycle in which carbon flows between organisms and the environment

Nitrogen cycle:

The flow of nitrogen between environment and the organisms

Nutrient Cycles:

Since such movement of elements and inorganic compounds is essential for maintenance of life, they are also called 'nutrient cycles'

Q14. Write a note on Carbon cycle.

Ans: See Q # 2 from Exercise (Understanding the Concept)

Q15. Explain how human activities have contributed to the k... balance in nature.

Ans: See Q # 5 from Exercise (Understanding the Concept)

Q16. Define nitrogen cycle.

Ans: Nitrogen cycle:

The flow of nitrogen between environment and the organisms is called nitrogen cycle.

Nitrogen is an important component of many biomolecules, like proteins and nucleic acids (DNA and RNA). Atmosphere is the reservoir of free gaseous nitrogen. Living organisms cannot pickup this gaseous nitrogen directly from atmosphere (except for nitrogen fixing bacteria). It has to be converted into nitrates to be utilised by plants

Q17. What are the different stages of Nitrogen cycle?

Ans: See Q # 3 from Exercise (Understanding the Concept)

Q18. Differentiate between Intraspecific and Interspecific interactions in ecosystem.

Ans: Intraspecific Interactions in ecosystem.

The interactions between the members of the same species are called intraspecific interactions.

Interspecific interactions in ecosystem:

The interactions between the members of different species are called interspecific interactions. Some important interactions among living organisms in ecosystems are given below.

i. Competiton ii. Predation ii. Symbiosis

Q19. Write notes on competition, predation and symbiosis.

Ans: See Q # 4 from Exercise (Understanding the Concept)

Q20. Describe the symbiosis between honeyguide bird and badger?

Ans: The honeyguide bird feeds on wax and the larvae present in honeycombs. It flies around looking for honeycombs, but it is not strong enough to open the comb. Badgers are large mammals that feed on honey. When a honeyguide bird goes to find honeycombs, the badger follows it. When the bird finds a honeycomb, it calls the badger.

Sometimes the bird has to stop and wait for the slow-moving badger. After reaching there, the badger opens the honeycomb and both of them eat their foods together. Traditionally, humans have also used these birds to find honeybee colonies.

Q21. Write a note on Global Warming.

Ans: Global Warming:

Increase in the temperature of the Earth; due to the addition of greenhouse gases in atmosphere, which do not allow solar radiations to reflect back into the space.

The addition of greenhouse gases (e.g. carbon dioxide, methane, ozone) in atmosphere increases the temperature of the Earth. These gases remain in the lowest part of Earth's atmosphere and do not allow solar radiations to reflect back into space. As a result, heat remains within the Earth's atmosphere and increases its temperature. This is called global warming.

Effects of Global Warming:

Due to global warming, polar ice-caps and glaciers are melting faster than the time taken for new ice layers to form. Sea water is also expanding causing sea levels to rise. Due to melting glaciers, rivers overflow and cause floods.

In 1990 United Nation established intergovernmental Panel on Climate Change (IPCC).It provides scientific advice to the world leaders on issues like the build-up of greenhouse gases and its prevention.

According to IPCC, Earth's surf. temperature has increased ≈ 0.2°C per decade in the past 30 years.

The Maldives' Survival

Scientists fear that the sea level is rising up to 0.9cm a year Rise in sea level has worst effects on coastal countries Most of the islands of the Maldives are less than 1 metre above sea level It is estimated that within 100 years, the Maldives might become uninhabitable and the citizens would be forced to evacuate

Q22. Write a note on Greenhouse Effect.

Ans: Greenhouse Effect:

The term 'Greenhouse Effect' refers to the phenomenon in which certain gases (called greenhouse gases) trap heat in the atmosphere These gases act like the glass in a greenhouse which does not allow the inner heat to escape When sunlight reaches the surface of the Earth much of its energy is transformed into heat energy The Earth surface reflects this heat energy towards space as infrared radiation

The greenhouse gases trap infrared radiation and send it back to Earth Carbon dioxide methane and nitrous oxide are important greenhouse gases Since 1800, the amount of Carbon dioxide in atmosphere has increased 30 % The amount of methane has more than doubled and the amount of nitrous oxide has increased about 8%

Q23. Write a note on Acid Rains. Highlight Some of the significant ill effects of acid rain.

Ans: Acid Rains:

When rain falls through polluted air, it comes across chemicals such as oxides of sulphur and nitrogen These chemicals interact with water vapours in the presence of sunlight to form sulphuric acid and nitric acid These acids remain as vapour at high temperatures

As temperature falls, the acids begin to condense into liquid form and mix with rain or snow, on the way down to the Earth This makes rain acidic with pH range of 3 to 6 .

Some of the significant ill effects of acid rain are:

i. Acid rain destroys the necessary nutrients present in the waters of rivers and lakes etc Its also lowers the pH of water Most of the aquatic animals cannot survive at this pH

ii. Acid rain washes nutrients out of soil, damages the bark and leaves of trees and harms root hairs Leaf pigments (chlorophyll) are also destroyed

iii. Metallic surfaces exposed to acid rain are easily corroded Fabrics paper and leather products lose their material strength or disintegrate easily

iv. Building materials such as limestone, marble dolomite, mortar and slate are weakened with acid rains because of the formation of soluble compounds

Thus acid rain is dangerous for historical monuments The building of famous Taj Mahal has been corroded at many places due to acid rains

Taj Mahal and its corroded door

Q24. Write a note on Deforestation.

Ans: Deforestation:

Deforestation means clearing of forests by natural causes or humans. Large areas of forests have been cleaned for agriculture, factories, roads, rail tracks and mining. Humans cut trees for getting wood (lumber), which is then used for making structures and for heat production. Human preys upon forest animals, which are the predators of many insect pests. In this way, insect pests destroy forests by eating the shoots and spreading diseases.

Effects of deforestation:

The effects of deforestation include floods, droughts, landslides and soil erosions, global warming and loss of habitat of many species.

Q25. Write a note on Overpopulation.

Ans: Overpopulation:

When the industrial revolution started some 250 years ago, the world population was at 600 million - that seems like a lot of people but now the world population is almost ten times at 6 billion and will grow to 8 billion by 2025. Better health facilities and lowered mortality rates have contributed in population growth.

Year	Population	Year	Population
1981	85,098,000	1999	134,790,000
1984	92,284,301	2002	144,902,409
1987	99,953,232	2005	155,772,000
1990	107,975,060	2008	166,111,487
1993	116,444,165	2009	169,708,303
1996	125,409,651	2010	173,510,000

THE POPULATION OF PAKISTAN **Source:** The World Bank

Q26. Write a note on Urbanization.

Ans: Urbanization:

Urbanization means growing of cities. People move from rural areas to cities in search of better jobs, education opportunities and higher standards of living. If there is rapid urban growth, the governments find it difficult to provide even the basic facilities like health, education, shelter, water, electricity etc. Most of the migrants in cities do not find good jobs and become the part of urban poor. There is overcrowding in schools, hospitals etc.

The slum areas increase in number and people living there are at great risk of diseases. Urbanization is a global problem and cannot be stopped but it can be managed. The current level of urbanization in Pakistan is about 32% which is not high global standards.

Planned urbanization:

A planned urbanization can solve many problems. The cities should have thick green belts in their surroundings to control pollution. The open spaces in cities should be reserved through zoning and land plans. The urban spread-out should also be controlled.

PAKISTAN: URBAN POPULATION (%age)
Source: The World Bank

Utilization of public transport instead of individual transports also proves effective way to manage urbanization.

Q27. Define pollution.

Ans: Pollution:

Pollution is defined as any undesirable change in the physical, chemical or biological characteristics of air, water and land that may harmfully affect living organisms and natural resources.

Q28. Define pollutants.

Ans: Pollutants:

The substances that actually cause pollution are called the pollutants. They may be the industrial effluents, domestic wastes, medical wastes etc. Pollutants are of two types i.e. biodegradable and non-biodegradable.

Q29. Write note on the causes and effects of the air and water pollutions.

Ans: See Q # 6 from Exercise (Understanding the Concept).

Q30. Write a note on causes and control of Land Pollution.

Ans: Land Pollution:

Land (soil) is an important resource as it is the basis for the growth of producers. In the recent times, soil has been subjected to pollution.

Causes of Land Pollution:

The pesticides used in agriculture have chemicals that stay in soil for long times. The acid rains change the pH of soil making it unsuitable for cultivation. The household and other city garbage lies scattered in soil in the absence of a proper disposal system. Materials like polythene block the passage of water into soil and so decrease the water-holding capacity of soil.

Many industries produce harmful chemicals which are disposed of without being treated. Improper disposal of nuclear wastes also causes radioactive substances to remain in soil for a long time. Open latrines in villages and some parts of cities are also the source of land pollution.

Control of Land Pollution:

There should be suitable and safe disposal of wastes including nuclear wastes.

Non-biodegradable materials like plastic, glass, metals etc. should be recovered and recycled. Inorganic pesticides should be replaced by organic pesticides.

Q31. What do you mean by conservation of nature?

Ans: Conservation of Nature:

Conservation of nature means the conservation of natural resources. Everything that we use or consume e.g. food, petrol etc. is obtained from natural resources. The renewable natural resources e.g. air are reproduced easily but the non-renewable resources (e.g. minerals and fossil fuels) are not replenished once they get depleted. We have to conserve the non-renewable resources because their reserves are limited and humans are heavily dependent on them for daily needs. The renewable resources too have to be judiciously used. To ensure sustainable use of resources in our environment, we should act upon the principle of The 3R' i.e. Reduce, Reuse, and Recycle.

Interesting Information

Unwanted, unpleasant and annoying ids are termed as noise. Noise is considered as a form of pollution. Immediate effects of noise pollution are annoyance and aggression and the long term effects are hearing loss, depression hypertension etc.

Interesting Information

According to estimates, at the current of increase, the average global temperature will go up by 3°C to 8°C in the next 100 years.

Interesting Information

There are more than 200 tanneries (industry where raw skin is treated to make leather) operating in Kasur city The industry discharges 9000 cubic metres of waste water daily into the nearby water bodies This water contains heavy metals and becomes a part of the underground water In 2003 a survey showed that two-thirds of residents and 72 percent of tannery workers suffered cancer infections of the kidney or loss of eyesight Tests showed that the drinking water was contaminated with lead mercury and chromium

Interesting Information

The Pakistan government and the United Nations Development Programme (UNDP) launched the Kasur Tannery Pollution Control Project The project has established an effluent treatment plant, chromium plant and a solid waste disposal site

Q32. What do you mean by the concept of 3Rs with reference to the conservation of natural resources?

Ans: See Q # 5 from Exercise (Short Questions)

Q33. Highlight the different Plans for the Conservation of Nature in Pakistan.

Ans: Plans for the Conservation of Nature:

i. In 1992 Pakistan developed and the National Conservation Strategy The main objectives of the strategy are conservation of natural resources and improved efficiency in the use of resources It also covers the policies for promoting efficiency and conservation of energy resources

The Federal Ministry of Environment has launched the National Drinking Water and Sanitation Policy It focuses on the provision of clean drinking water to entire population and the conservation of water resources

Water purification plants are being installed all over the country

ii. In 2006 the UNDP launched the project "Mass Awareness for Water Conservation and Management" The objective of the project was to launch a comprehensive awareness campaign for the conservation and management of water resources in Pakistan

iii. The organization SCOPE (Society for Conservation and Protection of Environment) works with government for mass awareness and research for the conservation of natural resources in Pakistan

iv. The WWF (old name is World Wildlife Fund but now it is called World Wide Fund for Nature) is working on many projects related to the conservation of nature

Q34. What are the different programmes of WWF-Pakistan.

Ans: Programmes of WWF-Pakistan:

The following are some important programmes of WWF-Pakistan (in collaboration with the government of Pakistan)

i. Improving sub-watershed management and environmental awareness around Ayubia National Park

ii. Plantation of the trees of Jatropha and Mangroves at District Thatta Sindh

iii. District-wise forest cover assessment of Pakistan
iv. Saving Wetlands Sky High Programme (for the conservation and management of high altitude wetlands)
v. Indus Basin Water Security Project (to protect the water-flow needed for the maintenance of river ecosystem and for the benefit of nearby areas)
vi. Regional Climate Risk Reduction in Himalayas

Interesting Information

Clean water, air, fuels, agricultural land and forests appeared to be plentiful earlier but now these are becoming scarce. If we continue depleting them like this we will be creating untold misery for ourselves and for our future generations.

Interesting Information

A recycling of one tonne of paper can save 17 trees

Interesting Information

We can add the R4 i.e. Reforest. Trees should be planted during the rains. Trees make our environment more cool, shady and green.

Q35. Briefly describe the basic information about dengue fever.

Ans: Basic information about dengue fever:

Dengue fever is a viral infection transmitted through a mosquito *Aedes aegypti*. It has become a major health problem in tropical and sub-tropical countries, including Pakistan. There are four types of dengue virus. Recovery from infection by one provides lifelong immunity against that virus but provides no protection against infection by the other three viruses. According to the World Health Organization there are 50 million dengue infections worldwide every year. Now, there are 2.5 billion people at risk from dengue.

The female *Aedes* mosquito gets the virus when it bites an infected person. When an infected mosquito bites another person, viruses enter his / her blood and attack white blood cells. Inside WBCs, viruses reproduce and destroy them. In severe cases, the virus affects liver and bone marrow. As a result there is a decrease in the production of blood platelets and patient suffers from bleeding. Other symptoms of dengue include high fever, severe headache, pain behind the eyes, muscle and joint pains and rash.

Sometimes, dengue fever converts into dengue haemorrhagic fever (DHF) or into dengue shock syndrome (DSS). DHF results in bleeding, low levels of blood platelets and blood plasma leakage. In DSS the blood pressure falls dangerously low.

There is no vaccine or treatment for dengue fever. At present, the only method of controlling dengue virus transmission is to check the spread of Aedes mosquitoes.

Aedes aegypti breeds primarily in the containers used for water storage, discarded plastic containers, used automobile tyres and other items that collect rainwater. The mosquitoes can be controlled through proper solid waste disposal and improved water storage practices. Small fish and crustaceans have also been used for killing the larvae of the mosquito. Insecticide sprays have not proved efficient in killing the mosquitoes, because spray does not penetrate all habitats of adult mosquitoes.

MULTIPLE CHOICE

1. **Which of the following is the abiotic component of the ecosystem?**
   A. Producers B. Herbivores
   C. Carnivores D. Oxygen
2. **When we eat onions, our trophic level is;**
   A. Primary consumer B. Secondary consumer
   C. Decomposer D. Producer
3. **Identify the correctly matched pair:**
   A. Rainfall - biotic factors in ecosystem
   B. Global warming - formation of fossil fuels
   C. Renewable natural resource - air
   D. Corn - secondary consumer
4. **In the food chain tree → caterpillar → robin → hawk → coyote, which is the secondary consumer?**
   A. Caterpillar B. Robin
   C. Hawk D. Coyote
5. **In ecosystems, the flow of______ is one way, while______ is/are constantly recycled**
   A. Minerals, energy B. Energy, minerals
   C. Oxygen, energy D. Glucose, water
6. **In the food chain "grass → rabbit→fox →bear→mushroom", how many types of decomposers are present?**
   A. 1 B. 2 C. 3 D. 4
7. **Organisms in the ecosystem that are responsible for the recycling of plant and animal wastes are:**
   A. Producers B. Consumers
   C. Decomposers D. Competitors

8. Which form of Nitrogen is taken by the producers of the ecosystem?

A Nitrogen gas B Ammonia
C Nitrites D Nitrates

Answers

1. D	2. A	3. C	4. B	5. B
6. A	7. C	8. D		

1. What are the different levels of ecological organization?

Ans: Levels of Ecological Organization:

In ecology, the levels of organization range from organism to biosphere. An organism may be unicellular or multicellular

Population:

A group of the organisms of the same species inhabiting a specific geographical area (habitat) at a particular time is called a population.

Community:

All the populations that live in a habitat and interact in various ways with one another are collectively called a community.

2. Define ecosystem and its components.

Ans: The self-sufficient unit of an environment that is formed as a result of interactions between its biotic community and the abiotic components is known as **an ecosystem.**

Components of Ecosystem:

Ecosystem comprises of two basic parts i.e.

i. Abiotic Components
ii. Biotic Components

Abiotic components:

The **abiotic components** include the non-living factors present in ecosystem. The important non-living factors are light, air, water, soil and the basic elements and compounds.

Biotic Components:

The **biotic components** comprise the living part (organisms) of the ecosystem. Biotic components are further classified as producers, consumers and decomposers

3. How the flow of energy is different from that of materials?

Ans: Flow of Energy in Ecosystem:

The flow of energy in different trophic levels of ecosystem is unidirectional. The following is an overview of the flow of energy in an ecosystem

Energy flow in an ecosystem

Sun is the primary source of energy:

The Sun is the primary source of energy for all ecosystems. Producers get solar energy and transform it into chemical energy by the process of photosynthesis. They store this energy in their tissues and also transform it into mechanical and heat energy during their metabolic activities.

Flow of energy in producers:

The energy in producers' tissues flows to herbivores when producers are eaten. Herbivores transform it into mechanical and heat energy during their metabolic activities and store the rest in their tissues. Carnivores eat herbivores and get energy. They also use it for their body activities and store the rest in their tissues. After the death of producers and consumers, the energy stored in their tissues is used by decomposers.

Law of Thermodynamics:

The storage and expenditure of energy in an ecosystem is in accordance with the basic law of thermodynamics i.e. 'energy can neither be created nor destroyed but can be transformed from one form into another'.

Note:

In an ecosystem there is,

i. Constant flow or transfer of energy from the Sun through producers to consumers and decomposers.
ii. A significant decrease in useful energy during transfer of energy at each trophic level.

Flow of Materials:

The materials flow from one trophic level to the next by means of food chains and food webs. A food chain is a series of organisms within an ecosystem, in which each organism feeds on the one before it and is fed by the one after it. For example, following is a food chain in an ecosystem.

A simple food chain

The base of food chain is always formed by a plant (producer). It is eaten by a primary consumer, which is preyed upon by a secondary consumer. The secondary consumer may be eaten by a tertiary consumer.

A food chain, can therefore, be represented as

Producer → Primary Consumer → Secondary Consumer → Tertiary Consumer

A food chain involves a nutritive interaction among the biotic components of an ecosystem. Usually there are 4 or 5 trophic levels. Shorter food chains provide greater available energy and vice -versa.

Food web:

In nature, food chains are very complex, as one organism may be the food source of many other organisms. Thus, instead of a simple linear food chain, there is a web-like structure formed by these interlinked food chains. Such interconnected food chains collectively make 'food web'. Food web can be defined as, "a network of food chains which are interconnected at various trophic levels.

A food web in grassland ecosystem

4. Define food chain and food web.

Ans: Food chain:

The senes of organisms in an ecosystem, in which an organism eats the preceding one and is eaten by the next one is called food chain.

Food web:

A network of interconnected food chains, has a number of feeding connections amongst different organisms of a community is called food web

OR (Second Answer)

Food Chain:

A simple chain of feeding relationship between three or four organisms is called a food chain

Food Web:

A food web is a diagram, of some sort, that links at least two food chains together Food webs describe how energy is passed throughout a section of an ecosystem (or an entire ecosystem)

5. What do you mean by the concept of 3Rs with reference to the conservation of natural resources?

Ans: To ensure sustainable use of resources in our environment, we should act upon the principle of The 3R' i e Reduce, Reuse, and Recycle

The R1: Reduce:

We should use the natural resources less and should not waste them We should use this principle at different places, in our daily lives We should not waste water, electricity, fuel etc

We should turn off the tap when not in use. We should bathe with a bucket instead of shower. The lights and fans should be off, when we are not in room. We should take public transport (like buses) or walk short distances instead of using motor fuel. We should not waste food and should give unused food to poor people

The R2: Reuse:

We should use things again and again We should not throw away materials such as glass containers, plastic bags, paper, cloth etc These should be reused at domestic levels rather than being thrown. It also reduces solid waste pollution.

The R3: Recycle:

Materials such as paper, plastic, glass etc can be recycled This decreases the volume of refuse and helps in the conservation of natural resources

UNDERSTANDING THE CONCEPT

1. Explain what do you mean by the pyramids of number and biomass.

Ans: i. Pyramid of Numbers:

It is the graphic representation of the number of individuals per unit area at various trophic levels. Usually, producers are present in large number, primary consumers are in lesser number, secondary consumers are fewer, and so on So, the producers are of smallest size but maximum in number while the tertiary consumers are larger in size but lesser in number

ii. Pyramid of Biomass:

It is the graphic representation of biomass present per unit area at different trophic levels. In a terrestrial ecosystem, the maximum biomass occurs in producers, and there is progressive decrease in biomass from lower to higher trophic levels

Pyramid of numbers in an ecosystem

Pyramid of biomass in an ecosystem

2. Write a note on Carbon cycle.

Ans: Carbon cycle:

The biogeochemical cycle in which carbon flows between organisms and the environment is called carbon cycle

Carbon atom is the principal building block of many kinds of biomolecules Carbon is found as graphite and diamond in nature It also occurs as carbon dioxide in atmosphere

Major source of carbon:

Major source of carbon for the living world is carbon dioxide present in atmosphere and water Fossil fuels like peat coal, natural gas and petroleum also contain carbon Carbonates of Earth's crust also give rise to carbon dioxide

Photosynthesis and Carbon:

The major process that brings carbon from atmosphere or water into living world is photosynthesis Producers take in carbon dioxide from atmosphere and convert it into organic compounds In this way carbon becomes a part of the body of producers This carbon enters food chains and is passed to herbivores carnivores and decomposers

Respiration:

Carbon dioxide is released back to environment by respiration of producers and consumers It is also released by the decomposition of organic wastes and dead bodies by decomposers

Combustion:

Burning of wood and fossil fuels also adds large amount of carbon dioxide into atmosphere

Green house effect and global warming:

Human activities have contributed to the loss of balance in nature because the balance of carbon cycle has been upset by human activities such as deforestation and excessive burning of fossil fuels As a result, the amount of carbon dioxide in atmosphere is increasing causing the green house effect and global warming

Note: Carbon cycle is a perfect cycle in the sense that carbon is returned to atmosphere as soon as it is removed

3. What are the different stages of Nitrogen cycle?

Ans: Stages of Nitrogen cycle:

Nitrogen cycling involves several stages

a. Formation of Nitrates:

It is done by the following ways

i. Nitrogen Fixation:

Conversion of nitrogen gas into nitrates is called nitrogen fixation It occurs in the following ways

a. Atmospheric nitrogen fixation:

Thunderstorms and lightning convert atmospheric gaseous nitrogen to oxides of nitrogen These oxides dissolve in water and form nitrous acid and nitric acid The acids in turn combine with other salts to produce nitrates It is called as atmospheric nitrogen fixation

b. Biological nitrogen fixation:

Some bacteria also have the ability to transform gaseous nitrogen into nitrates It is called biological nitrogen fixation Some of these nitrogen fixing bacteria live as symbionts and many are free-living

c. Industrial nitrogen fixation:

Nitrogen fixation is also done in industries In industrial nitrogen fixation, hydrogen is combined with atmospheric nitrogen under high pressure and temperature It produces ammonia which is further converted into ammonium nitrate.

Nitrogen cycle

ii. Ammonification and Nitrification:

Ammonification is the breakdown of the proteins of dead organisms and nitrogenous wastes (urea, uric acid etc) to ammonia It is done by ammonifying bacteria After the formation of ammonia, it is converted into nitrites and nitrates It is called nitrification and is done by nitrifying bacteria. First, ammonia is converted into nitrites by bacteria (e g Nitrosomonas) The nitrites are then converted into nitrates by other bacteria (e g Nitrobacter)

b. Assimilation:

The nitrates formed by the above processes, are absorbed by plants and are utilized for making proteins etc. Animals take nitrogenous compounds from plants. The utilization of nitrates by organisms is called assimilation.

c. Denitrification:

It is a biological process in which nitrates and nitrites are reduced to nitrogen gas by denitrifying bacteria. By this process, nitrogen is returned to atmosphere.

Note:

Excessive denitrification reduces soil fertility and is stimulated by water logging, lack of aeration and accumulation of organic matter in the soil.

4. Write notes on competition, predation and symbiosis.

Ans: i. Competition:

In ecosystems, the natural resources e.g. nutrients, space etc. are usually in short supply. So there is a competition among the organisms of ecosystem for the utilization of resources. The competition may be intraspecific or interspecific.

Intraspecific competition is always stronger and more severe than the interspecific competition. Competition helps in maintaining a balance between the available resources and the number of individuals of a species.

Plants also show competition for space, light, water and minerals.

ii. Predation:

It is an interaction between two animals of different species or between a plant and an animal. In predation, one organism (the predator) attacks, kills and feeds on other organism (the prey).

Some examples of predation are given below.

I. All carnivore animals are predators. For example, frog preys upon mosquito and fox preys upon rabbit. There are some examples where a predator is preyed upon by a second predator and then the second one is preyed upon by a third predator. For example, frog (predator 1) is preyed upon by a snake (predator 2) and the snake is preyed upon by an eagle (predator 3).

II. Certain plants (Pitcher plant, sundew, Venus fly trap etc.) are carnivorous and live as predators. Such plants live in the areas where minerals and other nutrients are lacking. They feed on insects to fulfill their nitrogen requirements. These plants have mechanism to attract insects. For example, they secrete sweet nectar that attracts the insects searching for food. Their leaves are also modified to capture the prey.

Predator Plants

Note:

Predation keeps the prey population under check, so as to maintain an ecological balance. Humans benefit from this interaction in the biological control of weeds and pests. In order to control pests in an area, their predators are released there

iii. Symbiosis:

It is a relationship between members of different species, in which they live together for longer or shorter periods of time

Types of Symbiosis:

Symbiosis is of three types.

a. Parasitism:

It is a type of symbiosis (between members of different Species) in which smaller partner (parasite) derives food and shelter from the body of larger partner (host) and, in turn, harms it.

Temporary Parasitism:

In temporary parasitism, the parasite spends most of its life cycle as independent free-living organisms. Only a part of its life cycle is spent as a parasite Leech, bed bug, mosquito are common temporary parasites of humans

Permanent Parasitism:

In permanent parasitism, the parasites spend their whole life cycle as parasites. Many disease causing bacteria and all viruses are permanent parasites.

Classification of Parasites:

Parasites may also be classified as ectoparasites and endoparasites.

Ectoparasites:

Ectoparasites live outside i.e. on the surface of host's body and get food from there. Mosquitoes, leeches, lice etc are the examples of ectoparasites

Endoparasites:

Endoparasites live inside the body of host and get food and shelter Bacteria, viruses, tapeworm, Ascaris, Entamoeba, Plasmodium etc. are the examples of endoparasites

Some endoparasites

Parasitic plants:

Some plants (e.g. Cuscuta, also called dodder) are parasites on other plants Parasitic plants grow special types of roots (haustoria) into host body and suck the required nutrients from the vascular tissues of host

Note: Host can survive without parasite but parasite cannot survive without host

b. Mutualism:

In this type of symbiotic interaction, both partners (of different species) get benefit and neither is harmed

For example:

Termites eat wood but are not able to digest it. A protozoan lives in its intestine. It secretes 'cellulase' enzyme to digest the cellulose of wood. In return, the termite provides food and shelter to the protozoan.

Rhizobium:

The nitrogen fixer bacteria *Rhizobium* live in the root nodules of leguminous plants like pea, gram etc. The bacteria obtain food and shelter from plants while in return they fix gaseous nitrogen into nitrates for the plant which is required for their growth

Figure 16.14: Termite, with a protozoan in its gut

Figure 16.15. Bacteria in root nodules

Termite, with a protozoan in its gut

c. Commensalism:

It is a type of symbiosis in which one partner is benefited while the other is neither benefited nor harmed. For example

Epiphytes:

Epiphytes are small plants found growing on other larger plants for space only. They absorb water and minerals from atmosphere and prepare their own food. The larger plants are neither benefited nor harmed in any way.

Sucker fish:

Sucker fish attaches to the surface of sharks by its sucker. In this way, the shark provides easy transport to the sucker fish to new feeding grounds

(a)

(b)

a An epiphyte orchid plant growing on a tree trunk

b A sucker fish attached with shark

5. Explain how human activities have contributed to the loss of balance in nature.

Ans: Loss of balance in nature:

Human activities contribute to climate change by causing changes in Earth s atmosphere in the amounts of greenhouse gases, aerosols (small particles), and cloudiness

The largest known contribution comes from the burning of fossil fuels, which releases carbon dioxide gas to the atmosphere Greenhouse gases and aerosols affect climate by altering incoming solar radiation and out- going infrared (thermal) radiation that are part of Earth's energy balance Changing the atmospheric abundance or properties of these gases and particles can lead to a warming or cooling of the climate system

Greenhouse Gases:

Human activities result in emissions of four principal greenhouse gases carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and the halocarbons (a group of gases containing fluorine, chlorine and bromine) These gases accumulate in the atmosphere causing concentrations to increase with time Significant increases in all of these gases have occurred in the industrial era All of these increases are attributable to human activities.

Carbon dioxide has increased from fossil fuel use in transportation, building heating and cooling and the manufacture of cement and other goods Deforestation releases CO_2 and reduces its uptake by plants Carbon dioxide is also released in natural processes such as the decay of plant matter

Methane has increased as a result of human activities related to agriculture, natural gas distribution and landfills Methane is also released from natural processes that occur, for example, in wetlands. Methane concentrations are not currently increasing in the atmosphere because growth rates decreased over the last two decades

Nitrous oxide is also emitted by human activities such as fertilizer use and fossil fuel burning Natural processes in soils and the oceans also release N_2O

The abundance of chlorofluorocarbon gases is decreasing as a result of international regulations designed to protect the ozone layer

Ozone is a greenhouse gas that is continually produced and destroyed in the atmosphere by chemical reactions In the troposphere, human activities have increased ozone through the release of gases such as carbon monoxide hydrocarbons and nitrogen oxide which chemically react to produce ozone As mentioned above halocarbons released by human activities destroy ozone in the stratosphere and have caused the ozone hole over Antarctica

6. Write note on the causes and effects of the air and water pollutions.

Ans: 1. Air Pollution:

Air pollution is one of the major environmental issues of today It is defined as the change of composition of air by the addition of harmful substances (e g industrial and automobile gases and particulate matter)

Sources of Air Pollution:

All sources of air pollution, are related to human activities. Burning of coal produces a lot of smoke and dust whereas burning of petroleum produces sulphur dioxide.

In addition to these, air pollutants include carbon monoxide, carbon dioxide, nitrogen oxides, hydrocarbons, particulate matter and traces of metals. Different industries produce air pollution in the following way.

Fertilizer industries release oxides of sulphur and nitrogen, hydrocarbons, particulate matter and fluorine.

Thermal industries are coal based and their pollutants are fly ash, soot and sulphur dioxide.

Textile industries release cotton dust, nitrogen oxides, chlorine, smoke and sulphur dioxide.

Steel industries release carbon monoxide, carbon dioxide, sulphur dioxide, phenol, fluorine, cyanide, particulate matter etc.

Effects of Air Pollution:

i. Smog formation:

When pollutants like hydrocarbons and nitrogen oxides combine in the presence of sunlight, smog is formed. This is a mixture of gases. It forms a yellowish brown haze especially during winter and hampers visibility. It also causes many respiratory disorders and allergies as it contains polluting gases.

ii. Acid rains:

The air pollutants like sulphur dioxide and nitrogen oxides react with water in the atmosphere producing acid rains.

iii. Ozone depletion:

The upper layer (stratosphere) of the atmosphere has ozone (O_3) which absorbs ultraviolet (UV) rays present in the sun's radiation. However, the air pollutants like chlorofluorocarbons (CFCs) destroy the ozone molecules and so break the ozone layer. Ozone holes are created which permit UV rays to reach the Earth's surface. The UV rays increase the temperature and also cause skin cancers.

The harmful effects of the UV rays are visible in the countries such as Australia and New Zealand where the rate of skin cancer is higher than the other regions of the world.

Control of Air Pollution:

For effective control of air pollution, it is important to create public awareness about the ill-effects of air pollution. Air pollution can be controlled by the following ways.

i. Afforestation:

It means the establishment of new forests by planting on non-forest areas. Forests are effective means to control air pollution because plants can filter and absorb air pollutants.

ii. Modification of industrial effluents:

The air pollutants coming from industries should be passed through filters and other devices, so that the particulate matter is removed before the waste gases are released out. The smoke producing units should have long chimneys to take the

polluting gases far above and then disperse over a larger area. Industries should also invest for solar cookers or for producing bio gas.

iii. Environment friendly fuels:

Lead-free fuels should be used in automobiles. Similarly, sulphur-free fuel should be used in coal-based industry to reduce pollution by sulphur dioxide.

2. Water Pollution:

It is the change in the composition of water by the addition of harmful substances. Water pollution severely affects the health of people.

Major pollutants of water:

Sewage is one of the major pollutants of water. It contains organic matter and the excreta of human and other animals. Organic matter encourages the growth of microorganisms which spread diseases.

The wastes of industries (acids, alkalis, dyes and other chemicals) are disposed in nearby water bodies. These wastes change the pH of water and are harmful or even fatal to aquatic organisms.

Certain industries release a lot of hot water from their cooling plants. It results in heating up of water bodies and kills aquatic life.

Fertilizers and pesticides enter into water bodies with the rain water flow and the ground water by seepage. These chemicals remain in water for a long time and can enter food chains. They cause a number of diseases in animals.

Oil tankers and offshore petroleum refineries cause oil leakage into water. Oil floats on the water surface and prevents atmospheric oxygen from mixing in water. So, aquatic animals begin to die due to oxygen shortage.

Some heavy metals e.g. lead, mercury, arsenic and cadmium also make the water polluted. Such metals can be present in the water, released from industrial and urban areas.

If water with such heavy metals is given to plants, the metals enter the vegetables that grow on these plants. Such contaminated vegetables are harmful for human health. Heavy metals reduce growth and development, and cause cancer and nervous system damage. Mercury and lead can cause joint diseases such as rheumatoid arthritis, and diseases of kidneys, circulatory system and nervous system.

Effects of Water Pollution;

The following are major effects of water pollution.

i. Eutrophication:

Enrichment of water with inorganic nutrients (nitrates and phosphates) is called eutrophication. The sewage and fertilizers contain large amount of inorganic material (nutrients). When sewage and fertilizers reach water bodies, the nutrients present in them promote algal blooms (excessive growth) there (Fig. 16.19). Rich algal growth leads to increase in the number of the decomposers. Decomposers use the oxygen present in water and it results in the depletion of oxygen. Algal bloom also reduces the light reaching the lower layers in water.

ii. Food chain contamination:

The non-biodegradable water pollutants may stay in water for long times. From water, they enter into small organisms, which are fed upon by fish. The fish in turn are fed upon by land animals including human.

iii. Epidemics:

Organic pollutants in water facilitate the growth of germs Such polluted water causes epidemics like cholera gastroenteritis etc

Control of Water Pollution:

Public should be made aware of the dangers of water pollution Before releasing the sewage into water bodies it must be purified through sewage treatment techniques Industrial wastes should also be treated before they are released into water bodies

- **Abiotic:**

The non-living components of the environment like water sunlight soil heat etc

- **Acid Rain:**

The rain containing sulphuric acid and nitric acid, with pH range of 3 to 6

- **Ammonification:**

The decomposition of protein of dead plants and animals and nitrogenous wastes to ammonia by ammonifying bacteria

- **Atmospheric nitrogen fixation:**

The conversion of atmospheric gaseous nitrogen to nitrates by thunderstorms and lightning

- **Biogeochemical Cycle:**

The cyclic pathway through which chemical elements move from environment to organisms and back to the environment

- **Biological nitrogen fixation:**

The conversion of gaseous nitrogen into nitrates by living organisms

- **Biosphere:**

The last level of ecological organization, all the ecosystems of the world together form the biosphere

- **Biotic:**

The living components of the environment, include producers, consumers and decomposers

- **Carbon cycle:**

The biogeochemical cycle in which carbon flows between organisms and the environment

- **Carnivore:**

The consumers which eat only animal flesh

- **Commensalism:**

A type of symbiosis in which one of the partners gets benefit while the other is neither benefited nor harmed

- **Competition:**

A symbiotic relationship between or among living things for resources such as food space shelter mate, ecological status etc

- **Consumer:**

The part of the biotic components of the ecosystem that consists of animals

- **Decomposer:**

An organism which decomposes the dead bodies and dead matter

- **Deforestation:**

Cleaning of forests by natural causes or by humans

- **Denitrification:**

The conversion of nitrates into nitrogen gas which is then released into the atmosphere. This is caused by bacteria and how they obtain their energy. A small amount is converted to usable forms by lightning in a process called atmospheric nitrogen fixation

- **Ecological pyramid:**

A representation of the number of individuals or amount of biomass or energy present in various trophic levels of a food chain

- **Environment:**

The sum total of physical (abiotic) and biotic conditions which influence the organism

- **Eutrophication:**

The enrichment of water with inorganic nutrients, the nutrients promote the growth of algae and it leads to increase in the number of the decomposers and depletion of oxygen

- **Food chain:**

The series of organisms in an ecosystem, in which an organism eats the preceding one and is eaten by the next one

- **Food web:**

A network of interconnected food chains, has a number of feeding connections amongst different organisms of a community

- **Global Warming:**

Increase in the temperature of the Earth, due to the addition of greenhouse gases in atmosphere, which do not allow solar radiations to reflect back into the space

- **Interspecific interactions:**

Interactions between the members of the different species

- **Intraspecific interactions:**

Interactions between the members of the same species

- **Mutualism:**

The symbiotic association in which both the partners get benefit and neither is harmed

- **Natural resources:**

The resources on Earth, which provide everything that humans use or consume

- **Nitrification:**

The oxidation of ammonia to nitrites and nitrates by the nitrifying bacteria

- **Nitrogen cycle:**

The flow of nitrogen between environment and the organisms

- **Nitrogen fixation:**

Conversion of nitrogen into nitrates

- **Non-renewable resource:**

A resource that is formed over very long periods, the rate of formation is extremely slow so cannot be replaced. e g minerals and fossil fuels

- **Overpopulation:**

Increase in population beyond the carrying capacity of an area or environment

- **Ozone:**

The O_3 gas, also present in the upper layer of the atmosphere where it absorbs the ultraviolet rays present in the sun's radiation

- **Parasitism:**

A type of interspecific interaction in which smaller partner (parasite) derives food and shelter from the body of larger partner (host) and harms the host

- **Phytoplankton:**

Photosynthetic organisms that float on the surface of water

- **Pollutant:**

The substance that causes pollution

- **Pollution:**

Undesirable change in the physical, chemical or biological characteristics of air, water and land that may harmfully affect living organisms and other resources

- **Predation:**

An interaction between animals of two species or an pant and an animal, in which the predator attacks, kills and feeds on the smaller animal called prey

- **Producer:**

An organism that produces organic compounds from inorganic compounds, an autotroph

- **Pyramid of biomass:**

The graphic representation of biomass present per unit area at different trophic levels in an ecosystem

- **Pyramid of numbers:**

The graphic representation of the number of individuals per unit area at various trophic levels in an ecosystem

- **Renewable resources:**

The resources which are replenished or reproduced easily e g sunlight air, wind etc

- **Symbiosis:**

Long or short term relationship between members of different species three forms are parasitism, commensalism and mutualism

CHAPTER # 17 BIOTECHNOLOGY

Q1. Define biotechnology and describe its importance.

Ans: Biotechnology:

The use of living organisms in systems or processes for the manufacture of useful products or for services for humankind

Old Biotechnology:

Although the term biotechnology is new the discipline itself is very old Fermentation and other such processes, which are based on the natural capabilities of organisms, are commonly considered as old biotechnology

Modern Biotechnology:

Genetic engineering i.e. the artificial synthesis, modification, removal addition and repair of the genetic material (DNA) is considered as modern biotechnology

Scope and Importance of Biotechnology:

The following are some areas of the application of biotechnology

i. Biotechnology in the Field of Medicine:

In the field of medicine, biotechnologists synthesized insulin and interferon (antiviral proteins) from bacteria and released for sale A large number of vaccines and antibodies, human growth hormone and other medicines have also been produced Various enzymes are being synthesized for medicinal as well as industrial use Gene therapy (treatment through genes) has become important in recent years Biotechnology also proved much beneficial in forensic medicine The study of DNA helps in the identification of criminals.

ii. Biotechnology in the Field of Food and Agriculture:

Fermented foods (e.g pickles, yogurt), malted foods (e.g powdered milk a mixture of barley, wheat flour and whole milk), various vitamins and dairy products are produced by using microorganisms. Wine and beer are produced in beverage industry Biotechnology has also revolutionized research activities in the area of agriculture

Transgenic:

Transgenic (organisms with modified genetic set-up) plants are being developed in which desirable characteristics are present e.g more yields and resistance against diseases, insects and herbicides Transgenic goats chickens cows give more food and milk etc Many animals like mice, goats cows etc have been made transgenic to get medicines through their milk, blood or urine

iii. Biotechnology and Environment:

Biotechnology is also being used for dealing with environmental issues like pollution control, development of renewable sources for energy, restoration of degraded lands and biodiversity conservation Bacterial enzymes are used to treat sewage water to purify. Microbes are being developed to be used as biopesticides biofertilizers, biosensors etc Such transgenic microorganisms are also used for the recovery of metals cleaning of spilled oils and for many other purposes

Q2. Write a note on Genetic engineering.

Ans: Genetic engineering:

The artificial synthesis modification, removal, addition and repair of the genetic material (DNA) is considered as modern biotechnology It is done to alter the characteristics of organisms The work on genetic engineering started in 1944 when it was proved that DNA carries the genetic information Scientists isolated the enzymes of DNA synthesis and then prepared DNA outside cells

In 1970s they were able to cut and paste the DNA of organisms In 1978 scientists prepared human insulin by inserting the insulin gene in bacteria Human growth hormone was also synthesized in bacteria

In 1990 the **Human Genome Project** was launched to map all the genes in human cell The complete map of human genome was published in 2002

Interesting Information

Human began using microorganisms as early as 4000 BC for making wine vinegar cheese yogurt etc Some of these processes have become a part of every home that we may even hesitate to refer them as biotechnology

Interesting Information

In Scotland, in 1997 an embryologist Ian Wilmut produced a sheep (Dolly) from the body cell of an adult sheep

Q3. Give an example how biotechnology is helping for better environment.

Ans: See Q # 4 from Exercise (Short Questions)

Q4. Briefly explain the process of fermentation:

Ans: Fermentation:

The process in which there is incomplete oxidation-reduction of the organic substrate (glucose)

In 1857 Pasteur convinced the scientific community that all fermentations are the results of microbial activity He showed that fermentation is always accompanied by the development of microorganisms There are many kinds of fermentation and each kind is a characteristic of particular microbial group

Carbohydrate fermentation and its products

Fermentations are classified in terms of the products formed. The initial steps of **carbohydrate fermentation** are identical to those of respiration. The process begins with glycolysis, in which the glucose molecule is broken into two molecules of pyruvic acid. Different microorganisms proceed the further reactions in different ways. It results in the formation of various products from pyruvic acid.

Types of Carbohydrates Fermentation:

The two basic types of carbohydrate fermentation are:

i. Alcoholic Fermentation (by yeast):

This fermentation is carried out by many types of yeast such as *Saccharomyces cerevisiae*. This process is quite important and is used to produce bread, beer, wine and distilled spirits. In this process, carbon dioxide is removed from pyruvic acid. The product i.e. acetaldehyde is then reduced to ethanol. The carbon dioxide produced during this fermentation causes the rise of the bread.

ii. Lactic Acid Fermentation (by bacteria):

In this process, pyruvic acid is reduced to lactic acid. It is carried out by many bacteria e.g. Streptococcus and many Lactobacillus species. It is quite important in dairy industry where it is used for souring milk and also for production of various types of cheese.

Interesting Information

Fears are also being expressed about the advances in biotechnology in terms of release of harmful organisms developed through recombinant DNA technology.

Q5. What are the products of the two types of carbohydrate fermentation?

Ans: See Q # 3 from Exercise (Short Questions)

Q6. How would you define fermentation with reference to biotechnology?

Ans: See Q # 1 from Exercise (Short Questions)

Q7. Describe the applications of fermentation in the field of fermented foods.

Ans: Applications of fermentation in fermented foods:

Fermentation often makes the food more nutritious, more digestible and tastier. It also tends to preserve the food, lowering the need for refrigeration. The following groups are included in the fermented foods.

i. Cereal products:

Bread is the commonest type of fermented cereal product. Wheat dough is fermented by *S. cerevisiae* along with some lactic acid bacteria.

ii. Dairy products:

Cheese and yogurt are important fermentation products. Cheese is formed when a milk protein is coagulated. This happens when the acid produced by lactic

acid bacteria reacts with milk protein Yogurt is made from milk by different lactic acid bacteria

iii. **Fruit and vegetable products:**

Fermentation is usually used, along with salt and acid, to preserve pickle fruits and vegetables

iv. **Beverage Products:**

Beer is produced from cereal grains which have been malted dried and ground into fine powder Fermentation of the powder is done by yeast This process breaks the glucose present in powder into pyruvic acid and then into ethanol Grapes can be directly fermented by yeasts to wine

Q8. Name any two industrial products made by fermentation. Also describe their uses in the industry.

Ans: See Q # 2 from Exercise (Short Questions).

Q9. What is a fermenter? What are the two types of fermentation carried out in fermenters?

Ans: See Q # 2 from Exercise (Understanding the Concept)

Q10. What are the Advantages of using Fermenters.

Ans: Advantages of using Fermenters:

For each biotechnological process, the environment provided to the organisms must be monitored and controlled Such a controlled environment is provided by fermenters

A fermenter optimizes the growth of the organisms by controlling many factors like nutrients, oxygen, growth inhibitors, pH and temperature

A fermenter may hold several thousand litres of the growth medium So fermenters allow the production of materials in bulk quantities

Massive amounts of medicines, insulin, human growth hormone and other proteins are being produced in fermenters and this production proves much inexpensive.

Interesting Information

The design and arrangements for continuous fermentation are more complex

Interesting Information

In fact fermenter constitutes the heart of any industrial fermentation process

Q11. Give introduction and objectives of genetic engineering.

Ans: Introduction of Genetic Engineering:

Genetic engineering or recombinant DNA technology involves the artificial synthesis, modification, removal, addition and repair of the genetic material (DNA) Genetic engineering developed in the mid-1970s when it became possible to cut DNA and to transfer particular pieces of DNA from one type of organism into another As a result, the characteristics of the host organism could be changed If host organism is a microorganism, such as a bacterium, the transferred DNA is multiplied many times as the microorganism multiplies. Consequently it is possible to obtain millions of copies of a specific DNA inside a bacterial cell

Objectives of Genetic Engineering:

The important objectives of genetic engineering are as follows

i. Isolation of a particular gene or part of a gene for various purposes such as gene therapy
ii. Production of particular RN A and protein molecules
iii. Improvement in the production of enzymes drugs and commercially important organic chemicals
iv. Production of varieties of plants having particular desirable characteristics
v. Treatment of genetic defects in higher organisms

Q12. What basic steps a genetic engineer adopts during the manipulation of genes?

Ans: See Q # 4 from Exercise (Understanding the Concept)

Q13. In biotechnology, what is meant by Genetically Modified Organism (GMO)? How is it made?

Ans: See Q # 5 from Exercise (Short Questions)

Q14. Describe the achievements of genetic engineering in medicine, agriculture and environment.

Ans: See Q # 3 from Exercise (Understanding the Concept)

Interesting Information

Before genetic engineering, 500 000 sheep brains were required to produce 5 mg human growth hormone

Q15. What are single cell proteins? Describe their importance.

Ans: See Q # 5 from Exercise (Understanding the Concept)

Interesting Information

It is known as single cell protein because the microorganisms used as production are unicellular individuals.

Interesting Information

SCP is gaining popularity day by day because it requires limited land area for production

MULTIPLE CHOICE

1. **Find the correct match for the fermentation product and the organism involved.**
   A Formic acid – Saccharomyces   B Ethanol - Saccharomyces
   C Ethanol – Aspergillus   D Glycerol - Aspergillus
2. **Which one is NOT an objective of genetic engineering?**

A Production of cheese and yogurt by lactic acid bacteria
B Isolation of a particular gene or part of a gene
C Production of RNA and protein molecules
D Correction of genetic defects in higher organisms

3. **Which of these is an anti-viral protein?**
A Urokinase
B Thymosin
C Insulin
D Interferon

4. **The first step in genetic engineering is;**
A Growth of the genetically modified organism
B Transfer of the Recombinant DNA into the host organism
C Isolation of the gene of interest
D Insertion of a gene into a vector

Answers

1. B	2. A	3. D	4. C

1. **How would you define fermentation with reference to biotechnology?**

Ans: Fermentation:

Fermentation is the process in which there is incomplete oxidation-reduction of glucose. Fermentation has been in the knowledge of man since centuries, but it was believed that it is purely a chemical process.

Fermentation in Biotechnology:

In beginning, the meaning of fermentation process was the use of microorganisms for the production of foods (cheese, yogurt, fermented pickles and sausages, soy sauce), beverages (beers, wines) and spirits. However in biotechnology the term "fermentation" means the production of any product by the mass culture of microorganisms.

2. **Name any two industrial products made by fermentation. Also describe their uses in the industry.**

Ans: Industrial Products:

Products	Microorganisms used	Some uses
Formic acid	*Aspergillus*	Used in textile dyeing, leather treatment, electroplating, rubber manufacture
Ethanol	*Saccharomyces*	Used as solvent, used in the production of vinegar and beverages
Glycerol	*Saccharomyces*	Used as solvent, used in the production of plastics, cosmetics and soaps, used in printing, used as sweetener
Acrylic acid	*Bacillus*	Used in the production of plastics

3. What are the products of the two types of carbohydrate fermentation?

Ans: Products of carbohydrate fermentation:

i. Alcoholic Fermentation (by yeast)

ii. Lactic Acid Fermentation (by bacteria

4. Give an example how biotechnology is helping for better environment.

Ans: Biotechnology and Environment:

Biotechnology is also being used for dealing with environmental issues like pollution control, development of renewable sources for energy, restoration of degraded lands and biodiversity conservation. Bacterial enzymes are used to treat sewage water to purify. Microbes are being developed to be used as biopesticides, biofertilizers, biosensors etc. Such transgenic microorganisms are also used for the recovery of metals, cleaning of spilled oils and for many other purposes.

5. In biotechnology, what is meant by Genetically Modified Organism (GMO)? How is it made?

Ans: Recombinant DNA is transferred to the target host. In this way, host organism is transformed into a genetically modified organism (GMO).

The GMO are provided suitable culture medium for growth to give as much copies of the gene of interest as needed.

The GMO contains the gene of interest and manufactures the desired product, which is isolated from culture medium.

UNDERSTANDING THE CONCEPT

1. Define biotechnology and describe its importance.

Ans: Biotechnology:

The use of living organisms in systems or processes for the manufacture of useful products or for services for humankind.

Old Biotechnology:

Although the term biotechnology is new, the discipline itself is very old. Fermentation and other such processes, which are based on the natural capabilities of organisms, are commonly considered as old biotechnology.

Modern Biotechnology:

Genetic engineering i.e. the artificial synthesis, modification, removal, addition and repair of the genetic material (DNA) is considered as modern biotechnology.

Scope and Importance of Biotechnology:

The following are some areas of the application of biotechnology.

i. Biotechnology in the Field of Medicine:

In the field of medicine, biotechnologists synthesized insulin and interferon (antiviral proteins) from bacteria and released for sale. A large number of vaccines and antibodies, human growth hormone and other medicines have also been produced. Various enzymes are being synthesized for medicinal as well as industrial

use. Gene therapy (treatment through genes) has become important in recent years. Biotechnology also proved much beneficial in forensic medicine. The study of DNA helps in the identification of criminals.

ii. Biotechnology in the Field of Food and Agriculture:

Fermented foods (e.g. pickles, yogurt), malted foods (e.g. powdered milk a mixture of barley, wheat flour and whole milk), various vitamins and dairy products are produced by using microorganisms. Wine and beer are produced in beverage industry. Biotechnology has also revolutionized research activities in the area of agriculture.

Transgenic:

Transgenic (organisms with modified genetic set-up) plants are being developed, in which desirable characteristics are present e.g. more yields and resistance against diseases, insects and herbicides. Transgenic goats, chickens, cows give more food and milk etc. Many animals like mice, goats, cows etc. have been made transgenic to get medicines through their milk, blood or urine.

iii. Biotechnology and Environment:

Biotechnology is also being used for dealing with environmental issues, like pollution control, development of renewable sources for energy, restoration of degraded lands and biodiversity conservation. Bacterial enzymes are used to treat sewage water to purify. Microbes are being developed to be used as biopesticides, biofertilizers, biosensors etc. Such transgenic microorganisms are also used for the recovery of metals, cleaning of spilled oils and for many other purposes.

2. What is a fermenter? What are the two types of fermentation carried out in fermenters?

Ans: Fermenter:

A device that provides optimum environment in which organisms can grow to produce biomass and to form the product is called fermenter.

Types of fermentation carried out in fermenters:

Fermentation is carried out in fermenters, in the following two ways.

i. Batch Fermentation:

In this process, the tank of fermenter is filled with the raw materials to be fermented. The temperature and pH for microbial fermentation is properly adjusted, and nutritive supplements are added.

A batch fermenter

All the material is steam sterilized. The pure culture of microorganisms is added to fermenter from a separate vessel. Fermentation proceeds and after the proper time the contents of fermenter are taken out. Fermenter is cleaned and the process is repeated. Thus, fermentation is a discontinuous process divided into batches.

ii. Continuous Fermentation:

In this process, the substrate is added to fermenter continuously at a fixed rate. This maintains the microorganisms in growth phase. Fermentation products are taken out continuously (Fig 17.4).

A continuous fermenter

3. Describe the achievements of genetic engineering in medicine, agriculture and environment.

Ans: Achievements of Genetic Engineering in Medicine:

Various achievements of genetic engineering are as follows.

Human Insulin:

Human insulin gene was transferred into bacteria. The genetically modified bacteria became able to synthesize insulin. Diabetics are now receiving this insulin.

Human growth hormone:

In 1977 an E. coli bacterium was created that was capable of synthesizing the human growth hormone.

Hormone Thymosin:

The hormone thymosin which may prove effective against brain and lung cancer has been produced by genetically modified microorganisms.

Beta-endorphin:

Beta-endorphin, a pain killer produced by the brain, has also been produced by genetic engineering techniques.

Vaccine:

Genetic engineers produced a safe vaccine against the foot and mouth disease (a viral disease in cattle, goats and deer). Similarly many vaccines have been produced against human diseases such as hepatitis B.

Production of insulin through genetic engineering

Interferons:

Interferons are anti-viral proteins produced by cells infected with viruses. In 1980, interferon was produced in the genetically modified microorganisms for the first time.

Urokinase:

The enzyme urokinase, which is used to dissolve blood clots, has been produced by genetically modified microorganisms.

Haemophilia:

Now it has become possible to modify the genes in the human egg cell. This can lead to the elimination of inherited diseases like haemophilia.

To cure blood diseases:

Genetic engineering techniques can also be used to cure blood diseases like thalassemia and sickle-cell anaemia, which result from defects in single genes. Normal genes could be transferred into the bone marrow.

Achievements of Genetic Engineering in Agriculture:

Fix nitrogen:

Genetic engineers have developed plants that can fix nitrogen directly from the atmosphere. Such plants need less fertilizers.

Achievements of Genetic Engineering in Environment:

Genetic engineering is also being used for dealing with environmental issues like pollution control, development of renewable sources for energy, restoration of degraded lands and biodiversity conservation. Bacterial enzymes are used to treat sewage water to purify. Microbes are being developed to be used as biopesticides, biofertilizers, biosensors etc. Such transgenic microorganisms are also used for the recovery of metals, cleaning of spilled oils and for many other purposes.

4. What basic steps a genetic engineer adopts during the manipulation of genes?

Ans: Basic Steps in Genetic Engineering:

All the above mentioned objectives can be obtained by some basic methodologies, such as:

i. Isolation of the gene of interest:

In the first step, the genetic engineer identifies the gene of interest in a donor organism. Special enzymes, called restriction endonucleases, are used to cut the identified gene from the total DNA of donor organism.

ii. Insertion of the gene into a vector:

A vector is selected for the transfer of the isolated gene of interest to the host cell. The vector may be a plasmid (the extra-chromosomal DNA present in many bacteria) or a bacteriophage. The gene of interest is attached with the vector DNA by using endonuclease (breaking enzymes) and ligase (joining enzymes). The vector DNA and the attached gene of interest are collectively called **recombinant DNA.**

iii. Transfer of recombinant DNA into host organism:

Recombinant DNA is transferred to the target host. In this way, host organism is transformed into a genetically modified organism (GMO).

iv. Growth of the GMO:

The GMO are provided suitable culture medium for growth to give as much copies of the gene of interest as needed.

v. Expression of the gene:

The GMO contains the gene of interest and manufactures the desired product, which is isolated from culture medium.

5. What are single cell proteins? Describe their importance.

Ans: Single-Cell Protein:

The protein content extracted from pure or mixed cultures of algae, yeasts, fungi or bacteria, the micro organisms are grown in fermenters where they produce a high yield of protein.

Importance of Single-Cell Protein:

a. Single-Cell Protein (SCP) refers to the protein content extracted from pure or mixed cultures of algae, yeasts, fungi or bacteria. For the production of single-cell proteins, the microorganisms are grown in fermenters. These microorganisms utilize

a variety of substrate like agricultural wastes industrial wastes natural gas like methane etc Microorganisms grow very vigorously and produce a high yield of protein The protein content produced by microorganisms is also known as novel protein or minifood

b. Due to over-population, the world is facing the problem of food shortage In future, the conventional agricultural methods might not be able to provide a sufficient supply of food (especially proteins)

c. For a better management of food shortage problems (in humans and domestic animals), the use of microbes as the producers of single-cell proteins has been successful on experimental basis This technique was introduced by Prof Scrimshow of Massachusetts Institute of Technology Scientist and food technologists believe that single-cell proteins will substitute the other protein-rich foods in human and animal feeds

d. All scientists recognize the significance of the production of single-cell proteins The microorganisms grow very vigorously and produce a high yield It has been calculated that 50 kilogram of yeast produces about 250 tons of protein within 24 hours Algae grown in ponds produce 20 tons (dry weight) of protein per acre/year This yield of protein is 10-15 times higher than soybeans and 20-50 times higher than corn When single-cell proteins are produced by using yeasts the products also contain high vitamin content

e. In the production of single-cell proteins, industrial wastes are used as raw materials for microorganisms It helps in controlling pollution

The use of single-cell proteins has good prospects in future because they contain all essential amino acids. Moreover, the production of single-cell proteins is independent of seasonal variations

- **Batch fermentation:**

The discontinuous fermentation process, divided into batches

- **Biotechnology:**

The use of living organisms in systems or processes for the manufacture of useful products or for services for humankind

- **Continues fermentation:**

A process in which cells or micro-organisms are maintained in culture in the exponential growth phase by the continuous addition of fresh medium that is exactly balanced by the removal of cell suspension from the bioreactor

- **Fermentation:**

The process in which there is incomplete oxidation-reduction of the organic substrate (glucose)

- **Fermenter:**

A device that provides optimum environment in which organisms can grow to produce biomass and to form the product

- **Genetically Modified Organism (GMO):**

The organism in which DNA (gene) from some other organism has been transferred

- **Recombinant DNA:**

The vector DNA and the attached gene of interest

- **Restriction endonucleases:**

Enzymes used to cut the gene from the total DNA of the organism

- **Single-Cell Protein:**

The protein content extracted from pure or mixed cultures of algae yeasts fungi or bacteria the micro-organisms are grown in fermenters where they produce a high yield of protein

- **Transgenic:**

Organisms with modified genome (genetic make-up)

- **Vector:**

(In Biology) The DNA (plasmid) or bacteriophage etc that transfers the isolated gene of interest to the host cell

GASEOUS EXCHANGE

Major Concepts:

10.1- Gaseous Exchange in Plants
10.2- Gaseous Exchange in Humans
10.3- Respiratory Disorders

Q.1. What do you mean by gaseous exchange? explain its importance.

Ans. (i) Gaseous exchange.

The process of taking in oxygen and giving out of carbon dioxide is termed as gaseous exchange.

(ii) Cellular respiration

Cellular respiration is the process in which the C-H bonds in food are broken by oxidation reduction reactions and the energy is transformed into ATP. In aerobic respiration, oxygen is used and there is complete oxidation of the food material. Carbon dioxide and water are also produced in this process.

(iii) Importance in breathing

The term **breathing** is used for the process through which animals take air in their bodies to get oxygen from it and then give out the air for getting rid of carbon dioxide. Thus breathing and respiration are not synonymous.

(iv) Existence of life

Organisms get the oxygen, needed for cellular respiration, from their environment and provide it to their cells. The carbon dioxide produced during cellular respiration is taken out of the cells and ultimately from the body. So gaseous exchange is very essential for existence of life.

Q.2. How gaseous exchange occurs in plants?

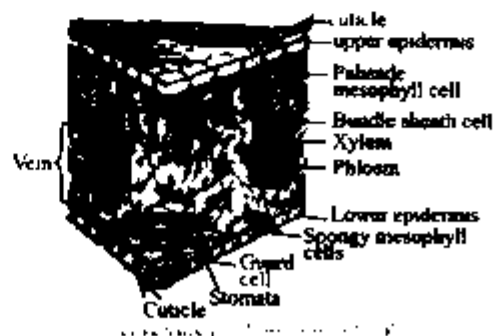
Ans. Gaseous exchange in plants

Plants have no organs or systems for the exchange of gases with the environment Every cell of the plant body exchanges gases with the environment by its own.

(i) Stomata

These are small opening in the walls of the leaves. The leaves and young stems have stomata in their epidermis. The gaseous exchange occurs through these stomata.

(ii) The mechanism of gaseous exchange in leaves

The inner cells of leaves (mesophyll) and stems also have air spaces among them; which help in the exchange of gases

Leaf cells face two situations. **During the daytime** when the mesophyll cells of leaves are carrying out photosynthesis and respiration side by side, the oxygen produced in photosynthesis is utilized in cellular respiration. Similarly the carbon dioxide produced during cellular respiration is utilized in photosynthesis. However, **during night** when there is no photosynthesis occurring, the leaf cells get oxygen from the environment and release carbon dioxide through stomata.

(iii) Gaseous exchange in stem:

In woody stems and mature roots, the entire surface is covered by bark which is impervious to gases or water. However, there are certain pores in the layer of bark. These are called the **lenticels**. The lenticels allow air to pass through them.

(iv) Gaseous exchange in roots:

Gases diffuse in and out of the general surface of the young roots. The gases are found in the soil surrounding the roots.

Important information

(i) In young stems and leaves, some gaseous exchange also occurs through the cuticle which is present over the epidermis.

(ii) The lenticels are slightly more raised than the general surface of the stem.

Q. Write a note on gaseous exchange in humans.

Ans. Gaseous exchange in humans:

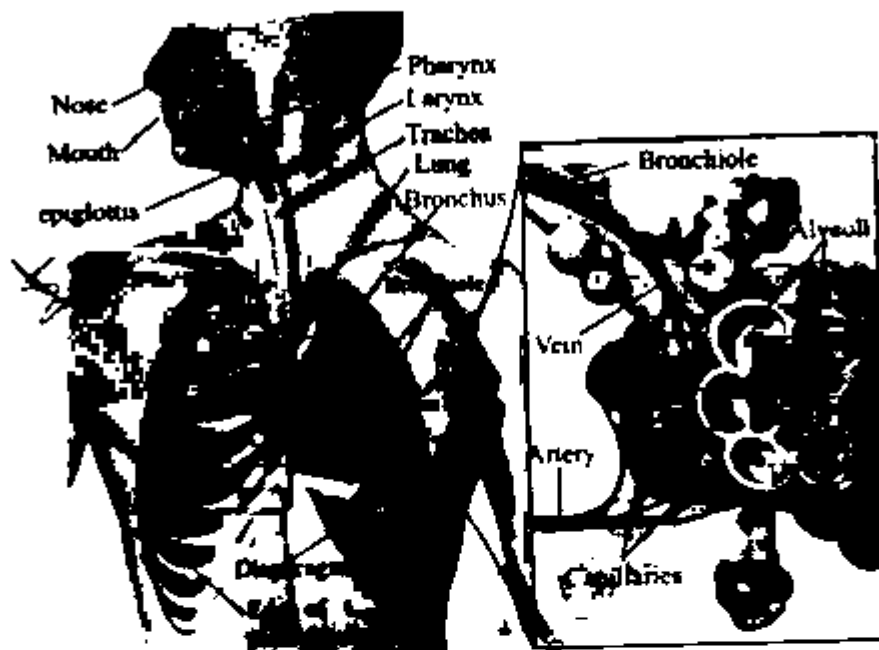
In humans and other higher animals the exchange of gases is carried out by the respiratory system. The respiratory system is divided into two parts.

(a) The air passageway (b) The lungs.

(a) The Air passage way:

The air passage way consists of the parts through which the outside air comes in the lungs and after the exchange of gases it goes out. This passage of air consists of the following parts.

(i) The Nasal cavity

The nose encloses the **Nasal cavity**. It opens to the outside through the openings called the **Nostrils**. The nasal cavity is divided into two portions by a wall. Each portion is lined by fine hairs and mucous which filter the dust particles from the air. The mucous also moistens and warms the incoming air and keeps its temperature nearly equal to that of the body.

The air passage way and the lungs

(ii) **Pharynx**

The nasal cavity opens into the pharynx by means of two small openings called internal nostrils. Pharynx is a muscular passage and is common to both food and air. It extends to the opening of the oesophagus and the larynx

The air goes from the pharynx into the larynx. The glottis is a narrow opening at the floor of pharynx which leads into larynx.

(iii) **Larynx**

The larynx is a box, made of cartilage. It is present between pharynx and trachea. It is also called the voice box. Two pairs of fibrous bands called vocal cords are stretched across the larynx. The vocal cords vibrate when the air passes through them. This vibration produces sounds.

(iv) **Trachea**

Larynx continues to the trachea, which is also called the windpipe. It is about 12 cm long tube which lies in front of the oesophagus. There are C-shaped cartilagenous rings in the wall of trachea. The cartilages keep the trachea from collapsing even when there is no air in it.

(v) **Bronchi**

On entering the chest cavity, the trachea divides into two smaller tubes called **bronchi** (Singular: bronchus). The bronchi also have cartilagenous plates in their walls. Each bronchus enters into the lung of its side and then divides into smaller branches

(vi) **Bronchioles.**

The bronchi continue dividing in the lungs until they make several fine tubes called **bronchioles.**

(vii) Alveolar ducts

The bronchioles progressively lose the cartilages as they become narrower. The bronchioles end as fine tubules called the **alveolar ducts.**

(viii) Alveoli

Each alveolar duct opens into a cluster of pouches called alveoli. The alveoli form the respiratory surface in human body. Each alveolus is a sac-like structure lined by a single layer of epithelial cells. It is bound on the outside by a network of capillaries.

The pulmonary artery from the heart containing deoxygenated blood enters the lungs and branches into arterioles and then into capillaries which surround the alveoli. These then join together to form the venules which form pulmonary vein. The pulmonary vein carries the oxygenated blood back to the heart.

Important Information

(i) The glottis is guarded by a flap of tissues called the epiglottis

(ii) The vibrations in vocal cords and the movements of lips, cheeks, tongue and jaws produce specific sounds which result in speech. Speech is inability that only humans are gifted with and this is one of the characteristics which has put human beings superior to all

(iii) The trachea and the bronchi are also lined with ciliated and glandular cells. The glandular cells secrete mucus which moistens the air and also traps any fine particles of dust or bacteria that have escaped from the nasal cavity. The cilia beat with an upward motion so that the foreign particles along the mucus are sent to the oral cavity from where it may be either swallowed or coughed out.

(ix) The Lungs

All the alveoli on one side constitute a lung. The two lungs are present in human body.

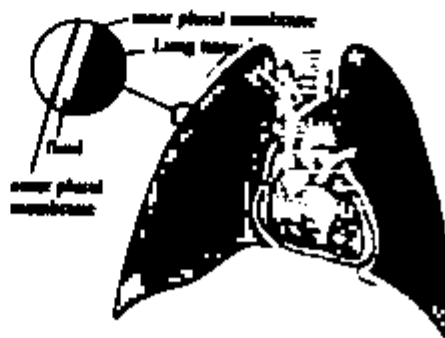
(i) Intercostal muscles.

There is a pair of lungs in the thoracic cavity. The chest wall is made up of 12 pairs of ribs and the rib muscles called **intercostal muscles.**

(i) Diaphragm

A thick muscular structure, called **diaphragm**, is present below the lungs. The left lung is slightly smaller and has two lobes and the right lung is bigger with three lobes. They are spongy and elastic organs. The lungs also have blood vessels that are the branches of the pulmonary arteries and veins. Each lung is enclosed by two membranes called the outer pleural membrane and the inner pleural membrane. The membranes enclose a fluid which provides lubrication for the free expanding and contracting of the lungs.

Q.4. Explain the mechanism of Breathing

Ans. The mechanism of Breathing

The physical movements associated with the gaseous exchange are called breathing. There are two phases of breathing i.e. inhalation and exhalation.

1. **Inspiration or Inhalation**

Definition

It is a process by which air is taken inside the body called as **Inhalation**

Mechanism of Inhalation

During inspiration, the rib muscles contract and ribs are raised. At the same time the dome-shaped diaphragm contracts and is lowered. These movements increase the size of the thoracic cavity, which reduces the pressure on lungs. As a result, the lungs expand and the air pressure within them also decreases. The air from outside rushes into the lungs to equalize the pressure on both sides.

2. **Expiration or Exhalation**

Definition

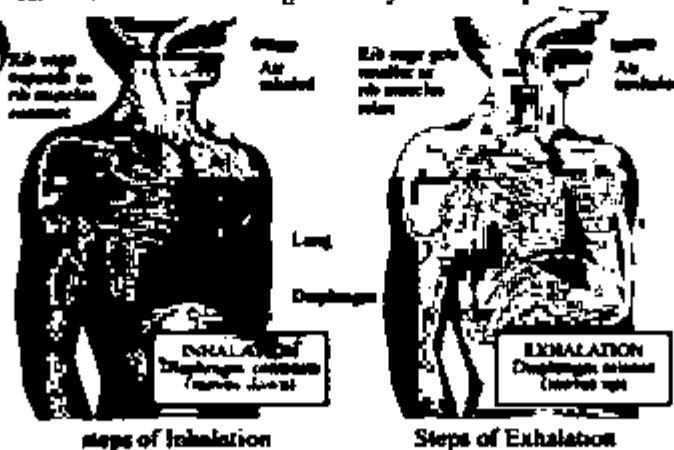
After the gaseous exchange in the lungs, the impure air is expelled out in **Exhalation.**

Mechanism of Exhalation

The rib muscles relax bringing the ribs back to the original position. The diaphragm muscles also relax and it gets its raised dome shape. This reduces the space in the chest cavity and increases the pressure on lungs. The lungs contract and the air is expelled out of them

3. **Role of respiratory center in Breathing**

Humans breathe 16 -20 times per minute in normal circumstances i.e. at rest. The rate of breathing is controlled by the respiratory center in the brain. The respiratory center is sensitive to the concentration of carbon dioxide in the blood. When we do exercise or some hard job our muscle cells carry out cellular respiration at greater rate. It results in the production of more carbon dioxide which is released in the blood. This greater than normal concentration of carbon dioxide stimulates the respiratory center of brain. The respiratory center sends messages to the rib muscles and diaphragm to increase the rate of breathing so that the excess carbon dioxide present in blood can be removed out of body. During exercise or other hard physical works the breathing rate may increase up to 30-40 times per minute.

Steps of Inhalation   Steps of Exhalation

Important information

The breathing movements are involuntary to a large extent. However, we can control the rate of breathing but not for a long time

Comparison between the inspired and the expired air		
Feature	Inspired Air	Expired Air
Amount of oxygen	21%	16%
Amount of carbon dioxide	0.04%	4%
Amount of nitrogen	79%	79%
Amount of water vapours	Variable	Saturated
Amount of dust particles	Variable	Almost none
Temperature	Variable	Almost equal to body temperature

Q. **What are Respiratory Disorders? Explain the causes and symptoms of Bronchitis.**

Ans. **Respiratory Disorders:** There are a number of respiratory disorders which affect people. The percentage of such disorders is particularly high in Pakistan. It is due to the more concentration of air pollutants not only in the urban but also in the rural atmosphere.

Bronchitis

Bronchitis is the inflammation of the bronchi or bronchioles. It results in excessive secretions of mucus into the tubes, leading to the swelling of tubular walls and narrowing of tubes.

(i) **Causes of Bronchitis**

It is caused by viruses, bacteria or exposure to chemical irritant e.g. tobacco smoke.

(ii) **Types of Bronchitis**

There are two major types of bronchitis acute and chronic

(a) **Acute Bronchitis**

The acute bronchitis usually lasts about two weeks and patients recovers with no permanent damage to the bronchi or bronchioles.

(b) **Chronic bronchitis**

In chronic bronchitis, the bronchi develop chronic inflammation. It usually lasts for three months to two years.

iii) Symptoms of bronchitis

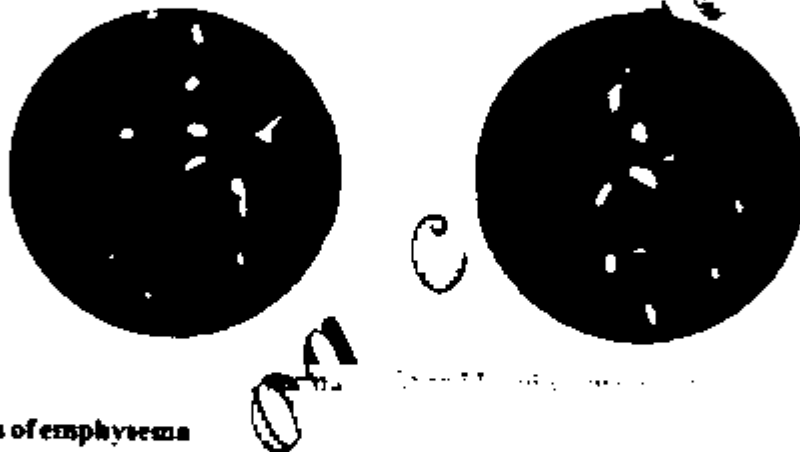
Symptoms of bronchitis include a cough, mild wheezing, fever, chills and shortness of breath (especially when doing hard job).

Important information

The majority of people diagnosed with chronic bronchitis are 45 years of age or older.

Q.6. What is Emphysema? Give its symptoms.

Ans. Emphysema

Emphysema is the destruction of the walls of the alveoli. It results in larger spaces but with less surface area for gaseous exchange. As lung tissue breaks down, the lungs do not come back to their original shape after exhalation. So air cannot be pushed out and is trapped in the lungs.

Symptoms of emphysema

The symptoms of emphysema include shortness of breadth, fatigue, recurrent respiratory infections and weight loss. By the time the symptoms of emphysema appear, the patient has usually lost 50% to 70% of his lung tissue. The level of oxygen in blood may get so low that it causes serious complications.

Q.7. What is Pneumonia? Give its causes and remedies.

Ans. Pneumonia

Pneumonia is an infection of lungs. If this infection affects both lungs, it is called double pneumonia.

Causes of Pneumonia

The most common cause of pneumonia is a bacterium, *Streptococcus pneumoniae*. Some viral (influenza virus) and fungal infections may also lead to pneumonia.

When the causative organisms enter the alveoli, they settle there and grow in number. They break the lung tissues and the area becomes filled with fluid and pus.

The symptoms of Pneumonia

The symptoms of pneumonia include a cold that is followed by a high fever, shivering, and a cough with sputum production. Patient may become short of breath. The patient's skin colour may change and become dusky or purplish. It is due to poor oxygenation of blood.

Vaccines of Pneumonia

Vaccines are available to prevent pneumonia caused by S. *pneumoniae*. Antibiotics are used in the treatment of this type of pneumonia.

Q.8. What is Asthma? Give its symptoms and remedies.

Ans. Asthma

Asthma is a form of allergy, in which there is inflammation of the bronchi, more mucous production and narrowing of the airways.

In asthma patients, the bronchi and bronchioles become sensitive to different allergens e.g. dust, smoke, perfumes, pollens etc. When exposed to any of such allergens, the sensitive airways show immediate and excessive response of constriction. In this condition, the patient feels difficulty in breathing.

Allergens: all those factors which are causing allergy called allergens

Symptoms of Asthma

The symptoms of asthma vary from person to person. The major symptoms include shortness of breath (especially with exertion or at night), wheezing (whistling sound when breathing out), cough and chest tightness.

The chemicals with ability to dilate the bronchi and bronchioles are used in the treatment of asthma. Such medicines are given in the form of inhalers.

Q.9. What is Lung Cancer? Give its symptoms and also explain passive smoking.

Ans. Lung Cancer

Lung cancer is a disease of uncontrolled cell divisions in the tissues of the lung. The cells continue to divide without any control and form tumours. The cellular growth may also invade adjacent tissues beyond the lungs.

Symptoms of Lung Cancer

The most common symptoms are shortness of breath, coughing and weight loss.

Causes of Lung Cancer

The main causes of any cancer include carcinogens (such as those in cigarette smoke), ionizing radiation and viral infection. Smoking is the main cause of lung cancer. This risk of lung cancer is significantly lower in nonsmokers. Cigarette smoke contains over 50 known carcinogens

Passive smoking

Passive smoking (the inhalation of Cancerous -smoke from another's smoking) is also a main cause of lung cancer. The smoke from the burning end of a cigarette is more dangerous than the smoke from the filter end.

Important information

(i) Lung cancer is the most common cause of cancer-related deaths and is responsible for more than 1.3 million deaths worldwide annually.

(ii) If a person stops smoking, the chance to develop cancer decreases as damage to the lungs is repaired and contaminant particles are gradually removed

Q.1 What are bad effects of Smoking?

Ans (i) Smoking is harmful due to the chemicals in cigarettes and smoke. Tobacco smoke contains over 4,000 different chemicals, out of which at least 50 are carcinogens and many are poisonous.

(ii) Many people think that lung cancer is the only smoking-related disease and it is the number one cause of death among smokers. But it is not right. Cigarette smoke affects the body from head to toe. Smokers have a much higher risk of developing a number of life threatening diseases.

(iii) Effects of Smoking

Smoking may also lead to the cancers in kidneys, oral cavity, larynx, breast, bladder and pancreas etc. Many chemicals in tobacco smoke damage the air passageway; which leads to emphysema and other respiratory disorders.

(iv) Effects of Smoking in circulatory system

Smoking also has effects on the circulatory system, the carbon monoxide present in tobacco smoke lessens the oxygen-carrying capacity of haemoglobin.

(v) The Arteriosclerosis.

Many other chemicals in smoke increase the production of blood platelets. When platelets are more than the normal numbers, they make the blood viscous and it can lead to arteriosclerosis.

(vi) Infections in lungs

Smokers are at greater risk of developing infections, particularly in the lungs. For example, smoking increases the risk of tuberculosis by two to four times, and of pneumonia by four times.

(vii) Effects on health

Smoking is also responsible for weakening and staining the teeth. Tooth loss is 2 to 3 times higher in smokers than in non-smokers.

(viii) Effects of smoking on social life

Smoking also affects the social life of a person. Smokers may face social un-acceptance because other people may not want to be exposed to others' smoke

Important information

(i) *Nicotine is a powerful poison and was widely used as an insecticide in the past. When inhaled through tobacco smoking, it reaches our circulatory system and not only hardens the walls of the arteries but also damages the brain tissues.*

(ii) *According to the WHO, the rates of smoking have declined in the developed world. In the developing world, however, it is rising by 3.4% per year as of 2002.*

(iii) ***The World No Tobacco Day***
The World No Tobacco Day is celebrated on the 31st of May every year.

(iv) *Non-smokers who are exposed to second-hand smoke (passive smoke) at home or work increase their heart disease risk by 25-30% and their lung cancer risk by 20-30%.*

HOMEOSTASIS

Major Concepts:

11.1- Homeostasis in Plants
11.2- Homeostasis in Humans
11.3- Urinary System of Humans
11.4- Disorders of Kidney

Q.1: Define Homeostasis, Give various forms of Homeostasis?

Ans: Homeostasis:

Homeostasis may be defined as the maintenance of the internal conditions of body at equilibrium, despite changes in the external environment.

Example 1

The core temperature of human body remains at about 37°C despite fluctuations in the surrounding air temperature.

Example 2

The blood glucose level remains about 1 g per liter despite eating a meal rich in carbohydrates. Body cells need the internal environment in which conditions do not change much. Stable internal conditions are important for the efficient functioning of enzymes.

Various processes of Homeostasis

1. **Osmoregulation:** It is maintenance of the amounts of water and salts in body fluids (i.e. blood and tissue fluids). The relative amounts of water and salts in body fluids and inside cells control the processes of diffusion and osmosis, which are essential for the functioning of cells.
2. **Thermoregulation:** The maintenance of internal body temperature is called thermoregulation. The enzymes of body work best at particular temperatures. Any change in body temperature may affect the functioning of enzymes.
3. **Excretion:** Excretion is also a process of homeostasis. In this process, the metabolic wastes are eliminated from body to maintain the internal conditions at equilibrium.

Important Definition

Metabolic waste means any material that is produced during body metabolism and that may harm the body.

How Homeostasis occurs in plants? Explain the various modes of Homeostasis

Homeostasis in Plants:

Plants respond to environmental changes and keep their internal conditions constant (homeostasis). They apply different mechanisms for the homeostasis of water and other chemicals (oxygen, carbon dioxide, nitrogenous materials etc)

1 **Removal of Extra Carbon dioxide and Oxygen**

In daytime, the carbon dioxide produced during cellular respiration is utilized in photosynthesis and hence it is not a waste product

At night, it is surplus because there is no utilization of carbon dioxide. It is removed from the tissue cells by diffusion. In **leaves** and young stems, carbon dioxide escapes out through stomata. In young roots,
carbon dioxide diffuses through the general root surface, especially through root hairs

Role of Mesophyll

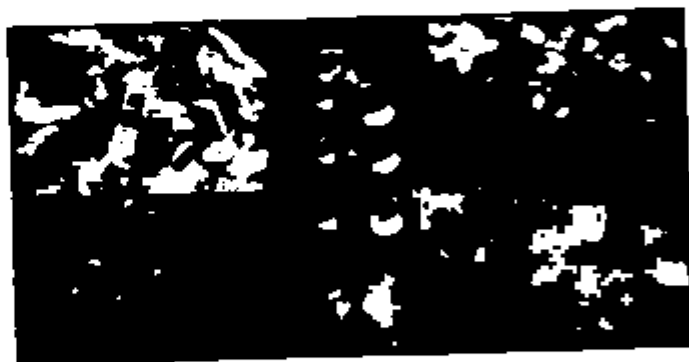
Oxygen is produced in mesophyll cells only during daytime, as a by-product of photosynthesis. After its utilization in cellular respiration, the mesophyll cells remove the extra amount of oxygen through stomata

2. **Removal of Extra Water**

The plants obtain water from soil and it is also produced in the body during cellular respiration. Plants store large amount of water in their cells for turgidity

Extra water is removed from plant body by **transpiration**. At night, transpiration usually does not occur because most plants have their stomata closed. If there is a high water content in soil, water enters the roots and is accumulated in xylem vessels.

Guttation

Some plants such as grasses force this water through special pores, present at leaf tips or edges, and form drops. The appearance of drops of water on the tips or edges of leaves is called **guttation**

Guttation in different plants

3 **Removal of other Metabolic Wastes:**

Plants deposit many metabolic wastes in their bodies as harmless insoluble materials. For example, calcium oxalate is deposited in the form of crystals in the leaves and stems of many plants e.g. in tomato

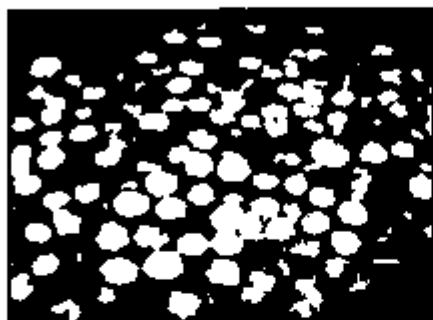
Shedding of Leaves

In trees which shed their leaves yearly, the excretory products are removed from body during leaf fall.

Other waste materials that are removed by some plants are resins by coniferous trees, gums by keekar, latex by rubber plant and mucilage by carnivorous plants and ladyfinger etc.

Resin drops from a cut tree Latex being extracted from a tree Mucilage drops on carnivorous plant.

Important Information

The removal of excretory products is a secondary function of leaf fall. If the leaves are not shed, the calcium oxalate just remains as harmless crystals in the leaves.

Important Information

Transpiration is the loss of water from plant surface in the form of vapours. Guttation is not to be confused with dew, which condenses from the atmosphere onto the plant surface.

Q.3: Write a note on Osmotic adjustments in Plants.

Ans: Osmotic adjustments in Plants: On the basis of the available amount of water and salts, plants are divided into three groups.

1. **Hydrophytes:**

Hydrophytes are the plants which live completely or partially submerged in freshwater. Such plants do not face the problem of water shortage. They have developed mechanisms for the removal of extra water from their cells. Hydrophytes have broad leaves with a large number of stomata on their upper surfaces. This characteristic helps them to remove the extra amount of water

Example The most common example of such plants

2. **Xerophytes:**

Xerophytes live in dry environments. They possess thick, waxy cuticle over their epidermis to reduce water loss from internal tissues. They have less number of stomata to reduce the rate of transpiration. Such plants have deep roots to absorb maximum water from soil.

Succulent Organs: Some xerophytes have special parenchyma cells in stems or roots in which they store large quantities of water. This makes their stems or roots wet and juicy, called **succulent organs.**

Example Cacti (Singular *Cactus*) are the common such plants

3. Halophytes:

Halophytes live in sea waters and are adapted to salty environments. Salts enter in the bodies of such plants due to their higher concentration in sea water.

Example

On the other hand, water tends to move out of their cells into the hypertonic sea water.

When salts enter into cells, plants carry out active transport to move and hold large amount of salts in vacuoles.

Salts are not allowed to move out through the semi-permeable membranes of vacuoles. So the sap of vacuoles remains even more hypertonic than sea water. In this way, water does not move out of cells. Many sea grasses are included in this group of plants.

Important Information

Osmosis is the movement of water from hypotonic solutions (less solute concentration) to hypertonic solutions (higher solute concentration), through semipermeable membrane.

Q.4 What is Homeostasis in Humans? Explain the organs of homeostasis

Ans: Homeostasis in Humans:

Like other complex animals, humans have highly developed systems for homeostasis. The following are the main organs which work for homeostasis:

(I) Lungs remove excess carbon dioxide and keep it in balance.

(ii) Skin performs role in the maintenance of body temperature and also removes excess water and salts.

(iii) The kidney filters excess water, salts, urea, uric acid etc from the blood and forms urine.

(I) Role of Skin in Homeostasis.

Human's skin consists of two layers.

(a) Epidermis:

Epidermis is the outer protective layer without blood vessels.

(b) Dermis:

While dermis is the inner layer containing blood vessels, sensory nerve endings, sweat and oil glands, hairs and fat cells.

Regulation of body temperature

Skin performs important role in the regulation of body temperature. The thin layer of fat cells in the dermis insulates the body. Contraction of small muscles attached to hairs forms 'Goosebumps' It creates an insulating blanket of warm air

Functions of Skin

Skin helps in providing cooling effect when sweat is produced by sweat glands and excess body heat escapes through evaporation. Metabolic wastes such as excess water, salts, urea and uric acid are also removed in sweat.

2. Lungs:

Our cells produce carbon dioxide when they perform cellular respiration. From cells, carbon dioxide diffuses into tissue fluid and from there into blood. Blood carries carbon dioxide to lungs from where it is removed in air.

Q.5: What is Urinary System of Humans and explain the structure of Kidney.

Ans: URINARY SYSTEM OF HUMANS:

The excretory system of humans is also called the urinary system. It is formed of one pair of kidneys, a pair of ureters, a urinary bladder and a urethra. Kidneys filter blood to produce urine and the ureters carry urine from kidneys to urinary bladder. The bladder temporarily stores urine until it is released from body. Urethra is the tube that carries urine from urinary bladder to the outside of body.

1. Structure of Kidney:

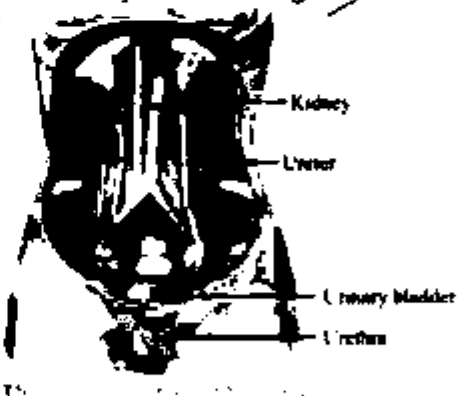
Kidneys are dark-red, bean shaped organs. Each kidney is 10 cm long, 5 cm wide and 4 cm thick and weighs about 27 grams. They are placed against the back wall of abdominal cavity just below diaphragm, one on either side of vertebral column. They are protected by the last 2 ribs. The left kidney is a little higher than the right.

Hilus: The concave side of kidney faces vertebral column. There is a depression, called hilus, near the centre of the concave area of kidney. This is the area of kidney through which ureter leaves kidney and other structures including blood vessels, lymphatic vessels and nerves enter and leave kidney. The longitudinal section of the kidney shows two regions.

(a) Renal Cortex: Renal cortex is the outer part of kidney and it is dark red in colour.

(b) Renal Medulla: Renal medulla is the inner part of kidney and is pale red in colour.

Pyramids: Renal medulla consists of several cone shaped areas called renal pyramids. **Pelvis:** Renal pyramids project into a funnel-shaped cavity called renal pelvis, which is the base of ureter.

Nephron: The functional unit of the kidneys is called nephron. There are over one million nephrons in each kidney. There are two parts of a nephron i.e. renal corpuscle and renal tubule.

(1) **Renal Corpuscle:** The renal corpuscle is not tubular and has two parts i.e. glomerulus and Bowman's capsule.

(a) **Glomerulus:** Glomerulus is a network of capillaries.

(b) **Bowman's capsule:** Bowman's capsule is a cup-shaped structure that encloses glomerulus.

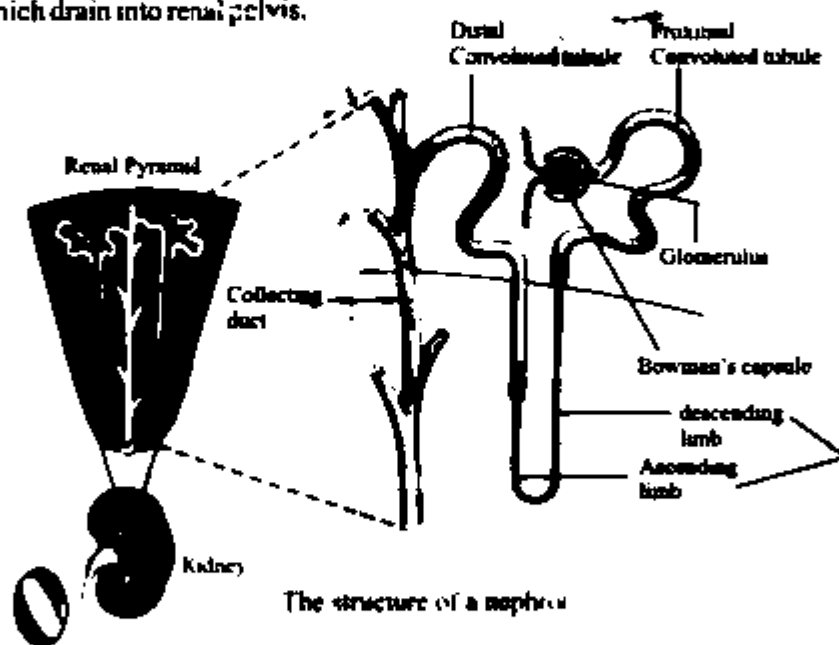
(2) **Renal Tubule:** The renal tubule is the part of nephron which starts after Bowman's capsule.

Proximal Convoluted Tubule: The first portion of Renal Tubule is called the **proximal convoluted tubule:**

Loop of Henle: Next portion of renal tubule is U-shaped and is called the **Loop** of Henle. The last portion of renal tubule is the **distal convoluted tubule.**

Collecting Duct: The distal convoluted tubules of many nephrons open in a single **collecting duct.**

Papillary Ducts: Many collecting ducts join together to form several hundred **papillary ducts** which drain into renal pelvis.

The structure of a nephron

Q.6: What are the functions of Kidney? Also explain Osmoregulatory Function of Kidney.

Ans: 1. Functioning of Kidney:

The main function of kidney is urine formation, which takes place in three steps.

(a) **Pressure Filtration:**

The first step is **pressure filtration.** When blood enters the kidney via the renal artery, it goes to many arterioles, and then to the glomerulus.

Glomerular Filtrate: The pressure of blood is very high and so most of the water, salts, glucose and urea of blood is forced out of glomerular capillaries. This material passes into the Bowman's capsule and is now called **glomerular filtrate.**

(b) Selective re-absorption:

The second step is the selective re-absorption. In this step about 99% of the glomerular filtrate is reabsorbed into the blood capillaries surrounding renal tubule. It occurs through osmosis, diffusion and active transport.

Proximal convoluted tubules

Some water and most of the glucose is reabsorbed from the proximal convoluted tubule. Here, salts are reabsorbed by active transport and then water follows by osmosis.

Descending limb

The descending limb of loop of Henle allows the reabsorption of water while

Ascending limb

The ascending limb of Loop of Henle allows the reabsorption of salts. The distal convoluted tubule again allows the reabsorption of water into the blood.

(c) **Tubular Secretion:** The third step is the tubular secretion. Different ions, creatinine, urea etc. are secreted from blood into the filtrate in renal tubule. This is done to maintain blood at a normal pH (7.35 to 7.45).

Urine: After the above mentioned steps, the filtrate present in renal tubules is known as **urine**. It moves into collecting ducts and then into pelvis.

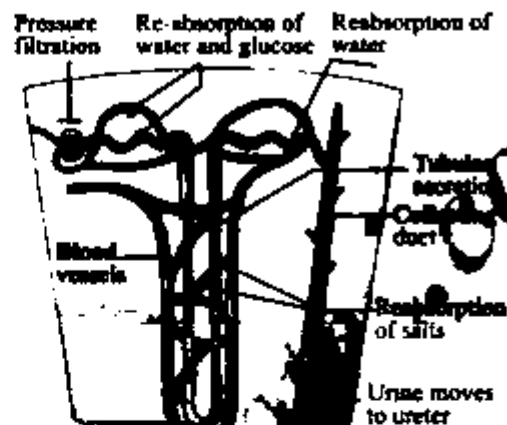
Important Information

At the final stage urine is only 1% of the originally filtered volume. The typical volume of urine produced by an average adult is around 1.4 litres per day.

Normal chemical composition of urine
(Source: NASA Contractor Report)

Water	[illegible]
Urea	[illegible]
Chloride ions	[illegible]
Sodium ions	[illegible]
Potassium ions	[illegible]
Other ions and compounds	[illegible]

1. Osmoregulatory Function of Kidney:

Osmoregulation: Osmoregulation is defined as the regulation of the concentration of water and salts in blood and other body fluids. Kidneys play important role in osmoregulation by regulating the water contents of blood. It is an important process as excessive loss of water dilutes them.

Hypotonic Medium: When there is excess water in body fluids, kidneys form dilut (**hypotonic**) urine For this purpose, kidneys filter more water from glomerular capillarie into Bowman's capsule Similarly less water is reabsorbed and abundant dilute urine produced. It brings down the volume of body fluids to normal.

Hypertonic Medium: When there is shortage of water in body fluids, kidneys filter les water from glomerular capillaries and the rate of reabsorption of water is increased. Les filtration and more reabsorption produce small amount of concentrated (**hypertonic**) urine It increases the volume of body fluids to normal. This whole process is under hormona control

Q.7: What are disorders of Kidney? Write a note.

(1) Kidney Stones **(2) Kidney Failure**

Ans: 1. Disorders of Kidney: The process by which a Kidney is unfit for its functions i called disorder of kidney There are many different kidney disorders

1 Kidney Stones:

When urine becomes concentrated, crystals of many salts e.g calcium oxalate calcium and ammonium phosphate, uric acid etc, are formed in it Such large crystals canno pass in urine and form hard deposits called **kidney stones**. Most stones start in kidney Som may travel to ureter or urinary bladder

Causes of Kidney Stones: The major causes of kidney stones are age, diet (containing mor green vegetables, salts, vitamins C and D), recurring urinary tract infections, less intake o water, and alcohol consumption.

Symptoms of Kidney Stones: The symptoms of kidney stones include severe pain in kidne or in lower abdomen, vomiting, frequent urination and foul-smelling urine with blood an pus. About 90% of all kidney stones can pass through the urinary system by drinking plent of water In surgical treatment, the affected area is opened and stone(s) are removed

Lithotripsy

Litotripsy is another method for the removal of kidney stones. In this method, non-electrica shock waves from outside are bombarded on the stones in the urinary system. Waves hit th dense stones and break them. Stones become sand-like and are passed through urine

Important Information

Abu Nasr al-Farabi (872-951) was a prominent scientist who wrote many books th contained information about kidney diseases. The genius Abu al-Qasim Al-Zahrawi (know as Albucasis 936-1013), is considered to be Islam's greatest surgeon who invented man surgical procedures including the surgical removal of stones from the urinary bladder Hi encyclopedia, Al-Tasrif ("The Method") contained over 200 surgical medical instrumen he personally designed.

2. Kidney (Renal) Failure:

Kidney failure means a complete or partial failure of kidneys to function

Causes of Kidney Failure:

Diabetes mellitus and hypertension are the leading causes of kidney failure In certai cases, sudden interruption in the blood supply to kidney and drug overdoses may also resu in kidney failure.

Symptom of Kidney Failure: The main symptom of kidney failure is the high level of urea and other wastes in blood, which can result in vomiting, nausea, weight loss, frequent urination and blood in urine. Excess fluids in body may also cause swelling of legs, feet and face and shortness of breath.

Treatment of Kidney Failure: The kidney failure is treated with dialysis and kidney transplant.

(a) Dialysis: Dialysis means the cleaning of blood by artificial ways. There are two methods of dialysis.

(i) Peritoneal Dialysis

In this type of dialysis, the dialysis fluid is pumped for a time into the peritoneal cavity which is the space around gut.

This cavity is lined by peritoneum. Peritoneum contains blood vessels. When we place dialysis fluid in peritoneal cavity, waste materials from peritoneal blood vessels diffuse into the dialysis fluid, which is then drained out. This type of dialysis can be performed at home, but must be done every day.

(ii) Haemodialysis

In haemodialysis, patient's blood is pumped through an apparatus called **dialyzer**. The dialyzer contains long tubes, the walls of which act as semi-permeable membranes.

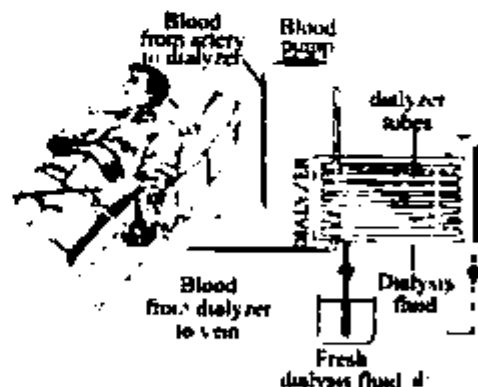
Blood flows through the tubes while the dialysis fluid flows around the tubes. Extra water and wastes move from blood into the dialysis fluid. The cleansed blood is then returned back to body.

Treatment: The haemodialysis treatments are typically given in dialysis centres three times per week.

(b) Kidney Transplant:

The dialysis needs to be repeated after every few days and is unpleasant for patients and attendants. Another treatment for the end-stage kidney failure is kidney transplantation. It is the replacement of patient's damaged kidney with a donor healthy kidney.

Donor: Kidney may be donated by a deceased-donor or living-donor. The donor may not be a relative of the patient. Before transplant, the tissue proteins of donor a matched. The donor's kidney is transplanted in patient's body and is connected to blood and urinary system. The average lifetime for a donated kidney is ten t When a transplant fails, the patient may be given a second kidney transplant. the patient is treated through dialysis for some intermediary time.

Problems after Transplantation: Problems after transplant may incl rejection, infections, imbalances in body salts which can lead to bone problem

Chapter 12 CO-ORDINATION AND CONTROL

Major Concepts:

12.1.Types of Co-ordination
12.2.Human Nervous System
12.3.Receptors in Humans
12.4.Endocrine System
12.5.Nervous Disorders

Q.1: Define Co-ordination. Give its examples and types?

Ans: Co-ordination:

The tissues and organs in the bodies of multicellular organisms do not work independently of each other. They work together performing their many tasks as the needs of the whole body. This means that these activities are co-ordinated. Co-ordination also enables the organism to respond to happenings in the world around it.

Example 1

One familiar example of coordination is the way in which muscles work together during movement. When a boy runs to catch a ball, he uses hundreds of muscles to move his arms, legs and back. His nervous system uses information from his sense organs and coordinates these muscles. Due to this coordination, the muscles contract in the correct sequence, power and length of time, but that is not all. Such activities involve many other kinds of coordination.

Example 2

Breathing and heart beat rates are increased, blood pressure is adjusted, and extra heat is removed fast from the body.

How does it happen? Life activities are controlled and coordinated i.e. body works as one unit, in which its different organs and systems cooperate and work in harmony with each other.

Example 3

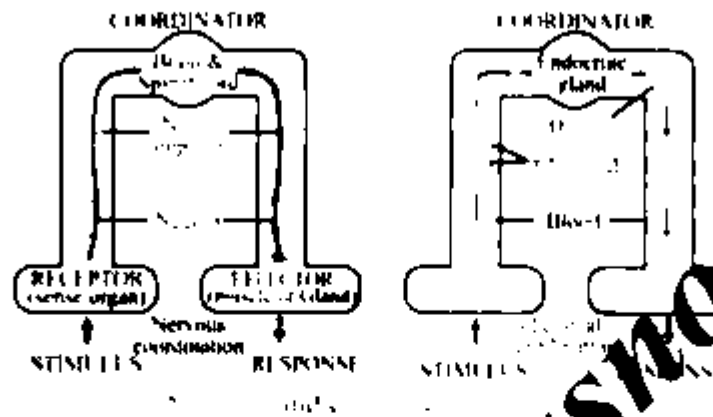
When we are writing something, our hands and fingers work in collaboration with our muscles, eyes, thoughts etc. and then very intricate movements result.

Types of Co-ordination

There are two types of coordination in organisms:

(i) Nervous coordination:

Nervous coordination brought about by nervous system and Co-ordination also takes place in unicellular organisms. The response to stimuli is brought about through chemicals.

Animals have both the nervous and chemical coordination systems in their bodies while plants and other organisms have only chemical coordination

Q.2 What are Actions of Coordination? Give its components

Ans Coordinated Action

A coordinated action has five components.

Stimulus ► Receptor ► Coordinator ► Effector ► Response

What happens when we touch a snail? We might have seen the flowers of sunflower plant moving towards the sun. What could be the reason for all this? Touch, light etc. are factors that can bring about certain responses in living organisms. These factors are called stimuli. We can define a stimulus as any change in environment (external and internal), which can provoke a response in organism.

Examples

More examples of stimuli are heat, cold, pressure, sound waves, presence of chemicals, microbial infection etc.

Stimuli are detected by special organs, tissues or cells of body

Example

For example sound waves are detected by ears, light is detected by eyes, chemicals in air are detected by nose and so on. The organs, tissues or cells which are specifically built to detect particular type of stimuli are called receptors.

These are the organs that receive information from receptors and send messages to Particular organs for proper action

Example

In nervous co-ordination, brain and spinal cord are co-ordinators. They receive information and send messages through neurons in the form of nerve impulses. On the other hand, in chemical coordination, various endocrine glands play the role of coordinators. They receive information in the form of various chemicals and send messages by secreting particular hormones in blood.

(iv) **Effectors**

These are the parts of body which receive messages from coordinators and produce Particular responses. In nervous co-ordination, neurons carry messages from co-ordinators (brain and spinal cord) to muscles and glands, which act as effectors. In chemical co-ordination, particular hormones carry messages from coordinators (endocrine glands) to particular target tissues, tissues, which act as effectors.

Example

For some hormones, nephrons act as effectors. Similarly, bones and liver act as effectors for many hormones.

(v) **Response**

On receiving the message from co-ordinators, the effector performs action. This action is called response.

Example

The pulling our hand away from something very hot and the movement of the flower of sunflower towards light are responses. Usually, nervous co-ordination produces immediate but short-living responses while chemical coordination produces slow but long-living responses.

Q.3: What is Nervous System? Explain the Structure of Neuron.

Ans: Human Nervous System

~~We have understood the basic model of the working of nervous system.~~ The nervous system in man and in other higher animals is composed of two major components i.e.

(i) **Central Nervous System:**

~~Central nervous system~~ Central nervous system comprises of co-ordinators i.e. brain and spinal cord.

(ii) **Peripheral nervous system.**

Peripheral nervous system consists of nerves that arise from central nervous system and spread in different parts of body. All these components are made of neurons. Now we will ~~first examine the structure and types of neuron and then we will~~ go to the divisions of nervous system.

Nerve Cell or Neuron

Nerve cell or neuron is the unit of the nervous system. The human nervous system consists of

billions of neurons plus supporting (neuroglial) cells. Neurons are specialized cells that are able to conduct nerve impulses from receptors to coordinators and from coordinators to effectors. In this way they communicate with each other and with other types of body cells.

Structure of Neuron

The nucleus and most of the cytoplasm of a neuron is located in its cell body.

Dendrite

Different processes extend out from cell body. These are called dendrites and axons. **Dendrites** conduct impulses toward cell body and axons conduct impulses away from cell body

Schwann cells :

Schwann cells are special neuroglial cells located at regular intervals along axons.

Myline Sheath

In some neurons, Schwann cells secrete a fatty layer called myelin sheath, over axons

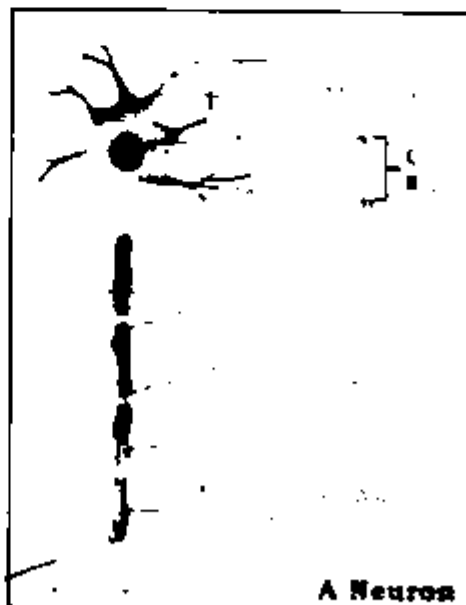
Nodes of Ranvier

Between the areas of myelin on an axon, there are non-myelinated points, called the called the **nodes of Ranvier**. Myelin sheath is an insulator to the membrane coated with this sheath does not conduct nerve impulse.
In such a neuron, impulses 'jump' over the areas of myelin going from node to node. Such impulses are called **saltatory** ('jumping') impulses. This increases the speed of nerve impulse.

Types f Neurons

On the basis of their functions, neurons are of three types;

1. Sensory neurons:
Sensory neurons conduct sensory information (nerve impulses) from receptors towards the CNS. Sensory neurons have one dendrite and one axon.
2. Interneurons:
Interneurons form brain and spinal cord. They receive information, interpret them and stimulate motor neurons. They have many dendrites and axons.
3. Motor neurons:
Motor neurons carry information from **interneurons** to muscle or glands (effectors). They have many dendrites but only one axon.

A Neuron

Nerve

A nerve means the union of several axons that are enveloped by a covering made of lipid. Based on the property of axons, the nerves are classified into three types.

Types of Nerve

1. **Sensory nerves** contain the axons of sensory neurons only.
2. **Motor nerves** contain the axons of motor neurons only.
3. **Mixed nerves** contain the axons of both i.e. sensory and motor neurons.

Important Information

1. A nerve impulse is a wave of electrochemical changes that travels along the length of neurons. Unlike ordinary cells, mature neurons never divide.
2. But a protein called nerve-growth-factor promotes the regeneration of broken nerve cells. The degenerating brain cells could be repaired, by using embryonic stem cells.
3. In certain parts of body, the cell bodies of many neurons form a group enveloped by a membrane. This is called ganglion.

Q.4 What are Divisions of the Nervous System? Write a note on Central Nervous System.

Ans: Divisions of the Nervous System

The details of the central and peripheral nervous systems are given below.

Central Nervous System

The central nervous system consists of brain and spinal cord.

(A) **Brain**

In animals, all the activities are under the control of brain. The structure of brain is suitable to perform this function. Brain is situated inside a bony cranium (part of skull).

Meninges

Inside cranium, brain is covered by three layers called **meninges**. Meninges protect brain and also provide nutrients and oxygen to brain tissue through their capillaries.

Cerebrospinal fluid (CSF)

The brain contains fluid-filled **ventricles** that are continuous with the **central canal** of spinal cord. Fluid within ventricles and central canal is called **cerebrospinal fluid (CSF)**. The

Divisions of Brain

There are three major regions in the brain of human and other vertebrates. These are forebrain, midbrain and hindbrain. Important parts of each of these regions are described below:

(a) Forebrain

Forebrain is the largest area of brain. It is most highly developed in humans. Following are the important parts of this region

Thalamus lies just below cerebrum. It serves as a relay centre between various parts of brain and spinal cord. It also receives and modifies sensory impulses (except from nose) before they travel to cerebrum. Thalamus is also involved in pain perception and consciousness (sleep and awakening)

Hypothalamus lies above midbrain and just below thalamus. In humans, it is roughly the size of an almond. One of the most important functions of hypothalamus is to link nervous system and endocrine system. It controls the secretions of pituitary gland. It also controls feelings such as rage, pain, pleasure and sorrow

Cerebrum is the largest part of forebrain. It controls skeletal muscles, thinking intelligence and emotions

Divisions of Cerebrum

It is divided into two **cerebral hemispheres**. The anterior parts of cerebral hemispheres are called **olfactory bulbs** which receive impulses from olfactory nerves and create the sensation of smell. The upper layer of cerebral hemispheres i.e. cerebral cortex consists of grey matter. The grey matter of nervous system consists of cell bodies and non-myelinated axons. Beneath this layer is present the white matter. The white matter of nervous system consists of myelinated axons. Cerebral cortex has a large surface area and is folded in order to fit in skull. It is divided into four lobes.

Important Information

Hippocampus is a structure found deep in the cerebrum. It functions for the formation of new memories. People with a damaged hippocampus cannot remember things that occurred after the but can remember things that occurred before damage

Lobe	Function
Frontal	Controls motor functions, permits conscious control of skeletal muscles and Coordinates movements involved in speech
Parietal	Contains sensory areas that receive impulses from skin
Occipital	Receives and analyzes visual information
Temporal	Concerned with hearing and smell

(b) Midbrain

Midbrain lies between hindbrain and forebrain and connects the two. It receives sensory information and sends it to the appropriate part of forebrain. Midbrain also controls some auditory reflexes and posture.

(c) Hindbrain

Hindbrain consists of three major parts.

(i) Medulla oblongata

Medulla oblongata lies on the top of spinal cord. It controls breathing, heart rate and blood pressure. It also controls many reflexes such as vomiting, coughing, sneezing etc. Information that passes between spinal cord and the rest of brain pass through medulla.

(ii) Cerebellum

Cerebellum is behind medulla. It coordinates muscle movements.

(iii) Pons

Pons is present on top of medulla. It assists medulla in controlling breathing. It also serves as a connection between cerebellum and spinal cord.

(B) SpinalCord

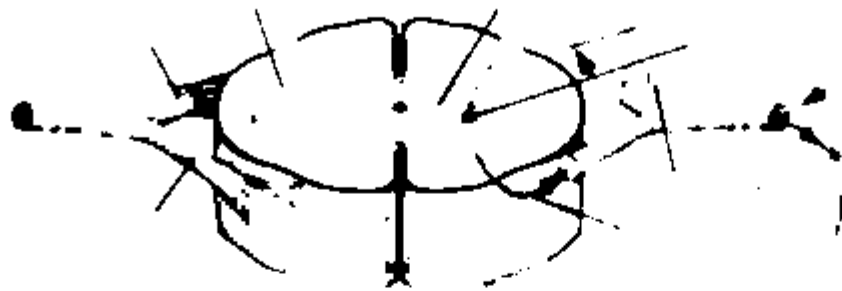
The medulla oblongata, pons, and midbrain connect the rest of brain to spinal cord. They are collectively referred to as brain stem.

Meninges

The spinal cord is in fact a tubular bundle of nerves. It starts from brain stem and extends to lower back. Like brain, spinal cord is also covered by meninges. The vertebral column surrounds and protects spinal cord.
The outer region of spinal cord is made of white matter (containing myelinated axons).

Mixed Nerves

The central region is butterfly shaped that surrounds the central canal. It is made of grey matter (containing neuron cell bodies).

31 pairs of spinal nerves arise along spinal cord. These are "**mixed**" nerves because each contains axons of both sensory and motor neurons. At the point where a spinal nerve arises from spinal cord, there are two roots of spinal nerve. Both roots unite and form one mixed spinal nerve.

Works of Spinal Cords

(i) The dorsal root contains sensory axons and a ganglion where cell bodies are located.
(ii) The ventral root contains axons of motor neurons.

Spinal cord performs two main functions.

1. It serves as a link between body parts and brain. Spinal cord transmits nerve impulses from body parts to brain and from brain to body parts.
2. Spinal cord also acts as a coordinator, responsible for simple reflexes.

Important Information

Spinal cord is the continuation of medulla oblongata. Spinal cord is roughly 40cm long and about as wide as your thumb for most of its length.

Q. What is Peripheral Nervous System?

Ans: **Peripheral Nervous System**

The peripheral nervous system (PNS) is composed of nerves and ganglia. Ganglia are the clusters of neuron cell bodies outside CNS. Nerves arise or lead to brain and spinal cord. So they are named as cranial and spinal nerves. Humans have 12 pairs of cranial nerves and 31 pairs of spinal nerves. Some cranial nerves are sensory, some are motor and some are mixed. On the other hand, all spinal nerves are mixed nerves. The cranial and spinal nerves make two pathways.

(i) Sensory Pathway

Sensory pathway (conducting impulses from receptors to CNS)

(ii) Motor Pathway

Motor pathway (conducting impulses from CNS to effectors)

Systems of Motor Pathway

Motor pathway makes two systems.

Somatic Nervous System

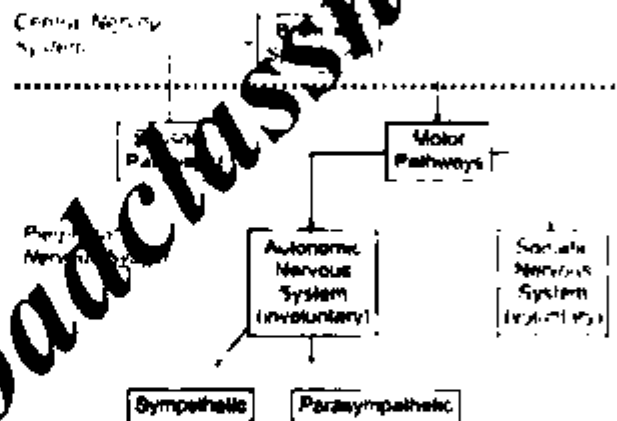
It is responsible for the conscious and voluntary actions. It includes all of the motor neurons that conduct impulses from CNS to skeletal muscles.

Autonomic Nervous System

It is responsible for the activities, which are not under conscious control. It consists of motor neurons that send impulses to cardiac muscles, smooth muscle and glands. Autonomic nervous system comprises of sympathetic system and parasympathetic system. Sympathetic nervous system prepares body to deal with emergency situations. This is often called the "fight or flight" response. During an emergency situation, this system takes necessary actions.

Example

It dilates pupils, accelerates heartbeat, increases breathing rate and inhibits digestion. When stress ends, the parasympathetic nervous system takes action and normalizes all the functions. It causes pupils to contract, promotes digestion and slows the rate of heartbeat and breathing rate.

Q. ...

Ans. Reflex Action

When central nervous system sends impulses to muscles and glands, two types of actions (responses) result.

Voluntary Action

The higher centres of brain control the conscious actions or voluntary actions.

In Voluntary Action

When impulses are not passed to the higher centres of brain, it results in responses which are not under conscious control. Such responses are called involuntary actions.

Reflex Action

Sometimes, the involuntary response produced by the CNS is very quick.
Such a response is called reflex action.

Reflex Arc

The pathway followed by the nerve impulses for producing a reflex action, is called

Example

The most common example of reflex action is the withdrawal of hand after touching a hot object. In this reflex action, spinal cord acts as coordinator. Heat stimulates temperature and pain receptors in skin. A nerve impulse is generated which is carried by sensory neurons to the interneurons of spinal cord. From interneurons, the impulse is passed to motor neurons, which carry it to the muscles of arm. As a result, the muscles contract to withdraw hand. During it, other interneurons transmit nerve impulses up to brain so that the person becomes aware of pain and what happened.

Sense Receptors In Humans

The organs or parts which are specifically built to detect particular types of stimuli are called sense organs or receptors. Main receptors in man are eyes, ears, nose, taste buds, receptors of touch, heat and cold etc.

Structure of Eye

Our eyes are located in small portions of skull known as the orbits or eye sockets. Eyelids wipe eyes and prevent dehydration. They spread tears on eyes, which contains substances for fighting bacterial infections. Eyelashes prevent fine particles from entering eye.

Longitudinal Section Through a Human Eye

Division of Eye Layers

The structure of eye can be divided into three main layers.

(a) Sclera and Cornea

The **outer layer** of eyeball consists of sclera and cornea. **Sclera** gives eye most of its white colour. It consists of dense connective tissue and protects the inner components of eye and maintains its shape. In the front, sclera forms the transparent cornea. Cornea admits light to the interior of eye and bends light rays so that they can be brought to a focus.

(b) Choroid

The middle layer is called **choroid.** It contains blood vessels and gives the inner eye a dark colour

(i) Iris

The dark colour prevents disruptive reflections within eye. Behind cornea, choroid bends to form a muscular ring, called iris

(ii) Pupil

There is round hole, called pupil, in the centre of iris. After striking the cornea, light passes through the pupil. The size of pupil is adjusted by the muscles of iris. Pupil constricts in bright light when the circular muscles of iris contract. Similarly, pupil dilates in dim light when the radial muscles of iris contract

(iii) Suspensory Ligament

Behind iris, there is a convex lens, which focuses light on retina. Lens is attached to **ciliary muscles of eye** via a ring of **suspensory ligament.** To clearly see an object far away, ciliary muscles are relaxed and lens becomes less convex. When ciliary muscles contract, lens becomes more convex and round

(c) Retina

The inner layer is sensory is called as **retina.** It contains the photosensitive cells called rods and cones and associated neurons

(i) Rods

Rods are sensitive to dim light

(ii) Cones

Cones are sensitive to bright light and so distinguish different colours. Retina has two points i.e. fovea and optic disc. Fovea is a pit in retina, directly opposite to lens and is densely packed with cone cells. It is largely responsible for colour vision and sharpness

(iii) Optic Disc

Optic disc is a point on retina where the optic nerve enters retina

(iv) Blind spot

There are no rods and cones at this point, that is why it is also referred to as the **blind spot.**

Division of Iris

The iris divides the cavity of eye into two chambers. The anterior chamber is in front of iris i.e. between cornea and iris; whereas the posterior chamber is between iris and retina.

Aqueous Humour

The anterior chamber contains a clear fluid known as **aqueous humour**

Vitreous Humour

The posterior chamber contains a jelly-like fluid known as **vitreous humour.** It helps maintain the shape of eye and suspends the delicate lens.

Light from objects enters eye and is refracted when it passes through cornea, aqueous humour, lens and vitreous humour. Lens also focuses light on retina. As a result, the image

falls on retina. Rods and cones generate nerve impulses in the optic nerve. These impulses are carried to the brain, which makes the sensation of vision.

Rhodopsin

Rods contain a pigment called **rhodopsin.** When light falls on rhodopsin, it breaks for generating a nerve impulse. In the absence of light, the breakdown products are again converted into rhodopsin.

Night Blindness

Body synthesizes rhodopsin from **vitamin A** and that is why the deficiency of vitamin A causes poor night vision. This problem is called **night blindness.**

Iodopsin

Cones also contain a pigment, known as **iodopsin.** There are three main types of cones and each type has a specific iodopsin. Each type of cones recognizes one of the three primary colours i.e. blue, green and red.

Colour Blindness

If any type of cones is not working well, it becomes difficult to recognize that colour. Such person is also not able to distinguish different colours. This disease is called **colour blindness** and it is a genetic problem.

Important Information

1. *In a human eye there are about 125 lakhs rods and 7 lakhs cones. Have you seen the eyes of cat and dog shining in the night? The reason for this is the presence of tapetum behind the eye which is a layer capable of reflecting light.*
2. *For a pilot, colour vision is essential so that he/she can recognize aircraft position lights, light-gun signals, airport beacon, approach-slope indicators, and chart symbols, especially at night. A pilot must have the ability to perceive these colours necessary for the safe performance of his/her duties.*

Q.8 Write a note on disorders of the Eye.
Ans. Disorders of Eye

The working of eye is affected by the changes in the shape of eyeball.

(a) Myopia

Myopia (Short sight) The elongation of eyeball results in myopia. Such persons are not able to see distant objects clearly. The image of a distant object is formed in front of retina.

Remedies

This problem can be rectified by using concave lens.

(b) Hypermetropia (Long sight)

Hypermetropia (Long sight) It happens when eyeball shortens. Such persons are not able to see near objects clearly. The image is formed behind retina.

Remedies

Convex lens is used to rectify this problem.

Q.10 What are the contributions of Muslim scientists?

Ans: Contributions of Muslim Scientists

1. Ali Ibn Isa (950 - 1012)

He was a famous Arab scientist. He wrote three books on ophthalmology (study of the diseases and surgery of eye). He described 130 eye diseases and prescribed 143 drugs to treat these diseases.

2. Ibn al-Haytham [illegible]

Ibn al-Haytham (965-1039), an Arab scientist, made significant contributions to the principles of eye and vision. He is regarded as the father of optics (study of the behaviour of light). His "Book of Optics" correctly explained and proved the modern theory of vision. He discussed the topics of medicine and eye surgery in his book. He made several improvements to eye surgery and accurately described the process of sight, the structure of eye, image formation in eye and visual system. Ibn al-Haytham also described the principles of pinhole camera.

Important Information

1. *Ibn al-Haytham's "Book of Optics-" has been ranked alongside a book of Isaac Newton. It is one of the most influential books ever written in the history of physics.*
2. *Owl is not able to see during day time. The reason for this is the deficiency of cones which receive and sense the bright light. But the presence of more rods gives it greater power of vision during night. All animals that search for prey during night have this characteristic.*

Ans: Ear:

Hearing is as important as vision. Our ear helps us in hearing and also to maintain the balance or equilibrium of our body. Ear has three main parts i.e. external ear, middle ear, and inner ear.

(a) External Ear

External ear consists of pinna, auditory canal and ear drum (tympanum). Pinna is the broad external part, made of cartilage and covered with skin. It helps to direct sound waves into auditory canal. There are special glands in the walls of auditory canal, which produce wax. The wax and the hairs in auditory canal protect ear from small insects, pathogens and dust. In additions to this, they help to maintain the temperature and dampness of auditory canal. Auditory canal ends in ear drum. This thin membrane separates external ear and middle ear.

The Human Ear

(b) Middle Ear

Middle ear is a chamber after ear drum. Three small bones, called middle ear ossicles, are present in a chain in middle ear. These movable bones include malleus, incus and stapes.

Malleus

Malleus is attached with ear drum, then comes incus and finally stapes that is connected with a membrane called oval window.

Eustachian Tube

Middle ear also communicates with the nasal cavity through Eustachian tube.

(c) Inner Ear

Inner ear consists of three parts:

(i) Vestibule: Vestibule is present in the centre of inner ear.

(ii) Semicircular Canals: Semicircular Canals are posterior to the vestibule.

(iii) Cochlea: The cochlea is made of three ducts and wraps itself into a coiled tube.

The Process of Hearing

The pinna of the external ear focuses and directs sound waves into auditory canal. The sound waves strike ear drum and produce vibrations in it. From ear drum, the vibrations strike

middle ear and produce further vibrations in malleus, incus and then stapes. From stapes, the vibrations strike the oval window and then reach the fluid-filled middle duct of cochlea. The fluid of cochlea is moved and receptor cells are stimulated. The receptor cells generate a nerve impulse, which travels to brain and is interpreted as sound.

Soundless world

Deafness is a state in which hearing is not possible. The defect of ear drum, cochlea, middle ear ossicles, or auditory nerve may cause deafness. Infection in Eustachian tube may spread to middle ear too. Ear drum may be damaged by an infection in auditory canal, excessive noise, strong blows on cheek, pointed objects entering auditory canal and attack from insects may also affect hearing.

Ears maintain the Balance of Body

Semicircular canals and vestibule help to maintain the balance of body. Semicircular canals contain sensory nerves which can detect any movement of head. Vestibule can detect any changes in the posture of body. The neurons coming from these two receptors reach cerebellum through the auditory nerve.

Important Information

A thunderstorm is characterized by the presence of lightning and a thunder. The lightning is caused by an electrical charge due to the movement of water droplets or crystals carried by the wind. The sudden increase in pressure and temperature from lightning produces rapid expansion of the air. This expansion of air produces a sound of thunder. The flash of lightning is followed by some seconds by a roar of thunder. This time difference is due to the fact that sound travels slower than light.

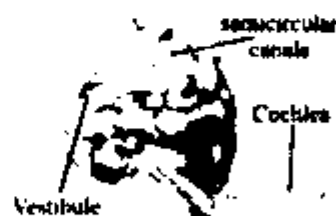
Structure of inner Ear

The activities such as growth, reproduction, maintenance of glucose concentration in blood, reabsorption of water in kidneys etc. need to be regulated. Endocrine system performs this job. This system uses chemicals to "communicate" with its effectors. These chemicals are known as hormones. A hormone is a specific messenger molecule synthesized and secreted by an endocrine gland. These glands are ductless and release their secretions (hormones) directly into bloodstream. Blood carries the hormones to target organs or tissues, upon which they act.

Exocrine Gland

Many glands in our body are exocrine. Such glands have ducts for releasing their secretions e.g. digestive glands, skin glands etc.

Important Endocrine Glands

It is a pea-shaped gland attached to the hypothalamus of brain. Many hormones (trophic hormones) of pituitary gland influence the secretions of other endocrine glands. However some hormones of this gland act directly on various tissues of body.

Lobes of Pituitary Gland

There are two lobes of pituitary gland i.e. anterior lobe and posterior lobe

(a) Anterior Lobe

It produces many hormones. One of its important hormones is somatotrophin (growth hormone). It promotes the growth of body.

Dwarfism

If the production of this hormone is diminished during growing age, the rate of growth decreases. This condition is called dwarfism. If this hormone is excessively produced during growing age, it leads to gigantism (very tall and overweight).

Acromegaly

If somatotrophin is excessively produced after growing age, internal organs and body extremities alone grow large. This condition is known as acromegaly. Such persons will have large hands, feet and jaw bones. Another important hormone secreted by the anterior lobe of pituitary gland is thyroid-stimulating-hormone (TSH). It stimulates thyroid gland to secrete its hormones. The remaining hormones of anterior lobe influence reproductive organs and also control adrenal glands.

(b) Posterior Lobe

The posterior lobe of pituitary gland stores and secretes two hormones i.e. oxytocin and vasopressin (antidiuretic hormone: ADH). These hormones are produced by hypothalamus (a part of brain).
Vasopressin increases the rate of reabsorption of water from nephrons.
When we have low amount of water in body fluids, pituitary gland secretes vasopressin and so more reabsorption of water occurs from nephrons into blood. In this way, body retains water and less amount of urine is produced. On the other hand, when body fluids have more than normal water, there is a decline in the secretion of this hormone.

Diabetes insipidus

If pituitary gland does not secrete this hormone in the required amount, less water is reabsorbed from nephrons and there is excessive loss of water through urine. This condition is known as diabetes insipidus. The hormone, oxytocin stimulates the contraction of uterus walls in mother at birth. Moreover, this hormone is necessary for the ejection of milk from breast.

Thyroid gland

This is the largest endocrine gland in human body. It is present in neck region, below larynx, and produces a hormone thyroxin. Iodine is required for the production of this hormone.

Goitre

If a person lacks iodine in diet, thyroid gland cannot make its hormone. In this condition, thyroid gland enlarges. This disorder is called goitre.

Hypothyroidism

Thyroxin increases the break down of food (oxidation) and release of energy in body. It is also responsible for the growth of body. Hypothyroidism is caused by the under production of thyroxin. It is characterized by low energy production in body and slowing down of heart-beat.

Hyperthyroidism

Hyperthyroidism is caused by over-production of thyroxin. Its symptoms are increase in energy production, increased heart-beat, frequent sweating and shivering of hands.

Calcitonin

The thyroid gland produces another hormone called calcitonin. It decreases the level of calcium ions in blood and promotes the absorption of calcium from blood into bones.

3. Parathyroid glands

These are four glands situated on the posterior side of thyroid gland. They produce a hormone known as **parathormone**. It increases the level of calcium ions in blood. When there is increased production of parathormone, more than normal calcium salts are absorbed from the bones and added to blood. Consequently the bones become brittle. If there is deficiency in the production of parathormone, blood calcium level falls. It leads to tetany, which affects the functioning of muscles.

4. Adrenal glands

Two adrenal glands are situated above kidneys. Each adrenal gland consists of two parts. The outer part is cortex and the inner Part is medulla.

Epinephrine

Adrenal medulla secretes a hormone called epinephrine or adrenaline in response to stress. It prepares our body to overcome emergency situations. Therefore, adrenaline is also termed as 'emergency hormone'.

Tetany

Tetany is marked by sharp flexion of the wrist and ankle joints, muscle twitching, cramps and convulsions. It is due to decreased blood calcium level which makes the nerves and muscles more excitable.

[illegible]

The [illegible] has two functions. The major part of pancreas is a ducted (exocrine) gland. This portion secretes digestive enzymes, through a duct, into the small intestine.

Islets of Langerhans

Some portions of pancreas serve as ductless (endocrine) gland. This portion contains groups of endocrine cells referred to as **islets of Langerhans**. These islets secrete two hormones i.e. insulin and glucagon.

Glucagon

Glucagon influences the liver to release glucose in blood and so the blood glucose concentration rises.

Insulin

Insulin influences the liver to take excess glucose from blood and so the blood glucose concentration falls. If a person's pancreas does not make normal quantity of insulin, the blood glucose concentration rises and we say that the person has diabetes **mellitus.**

Diabetes Mellitus

Persons with diabetes have loss of body weight, weakening of muscles and [illegible]. The disease can be controlled by insulin administration. Formerly, insulin [illegible] from animals was used for this purpose. But now human insulin produced from [illegible]cteria through genetic engineering is available.

Blood Glucose After 8-10 hours fast		Blood Glu[illegible] hours after a 75 g[illegible]ucose drink	
BGC	**Diagnosis**	**B[illegible]**	**Diagnosis**
From 70 to 99 mg/100ml	Normal	Less [illegible] mg/100ml	Normal
From 100 to 125 mg/100ml	Pre-diabetic	From [illegible] 200 mg/100ml	Pre-diabetic
126 mg/100ml and above	Diabetic	[illegible]ver 20[illegible] mg/100ml	Diabetic

Import[illegible]rmation

Blood Glucose Concentration (B[illegible]) [illegible]st
The amount of glucose in blood [illegible] by this test. It is used to diagnose diabetes. Blood glucose, may be measured on a [illegible] basis (collected after an 8 to 10 hour fast), randomly (anytime) and after a meal. The re[illegible]lts of some BGC tests are given here.

6. Gonads

Testes (*Singular* tes[illegible]) [illegible] ovaries are the male and female reproductive organs i.e. gonads.

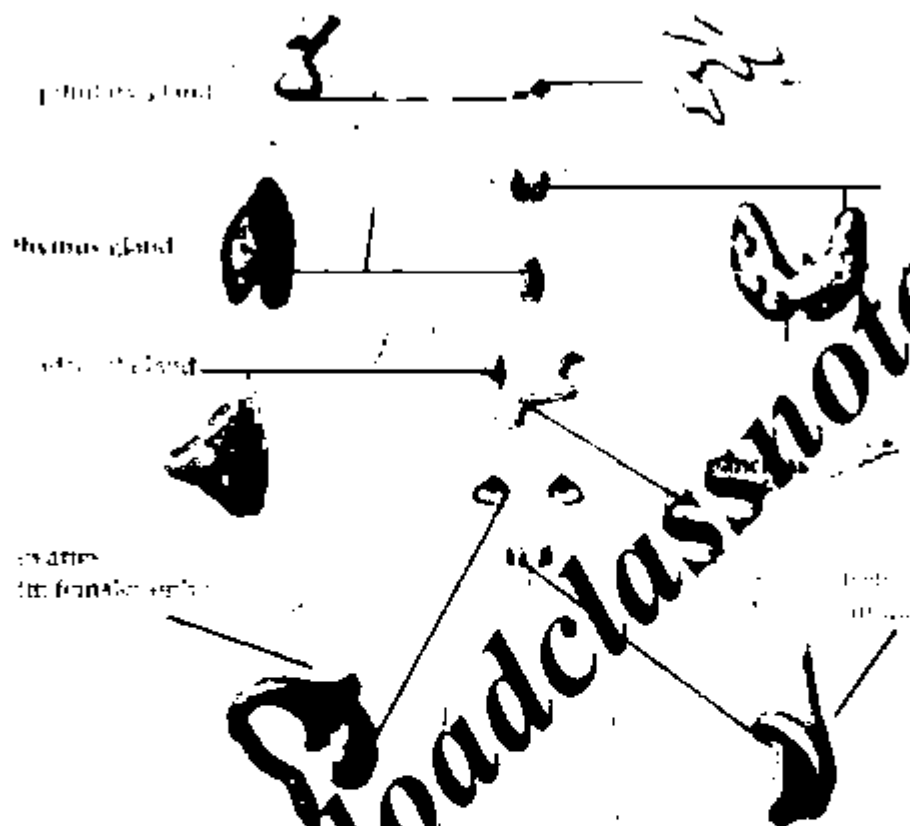
Sex Hormo[illegible]

In addi[illegible] to producing gametes, gonads also secrete hormones, called sex hormones.

Testost[illegible]rone

[illegible]es secrete hormones e.g. **testosterone**, which is responsible for the development of [illegible] secondary sex characters such as growth of hair on face and coarseness of voice etc.

[illegible]rogen and Progesterone

Ovaries secrete **estrogen** and **progesterone**, which are responsible for the development of female secondary characters such as the development of breast etc.

Human Endocrine system

Q.[illegible] Write note on Feedback Mechanisms of Endocrine glands

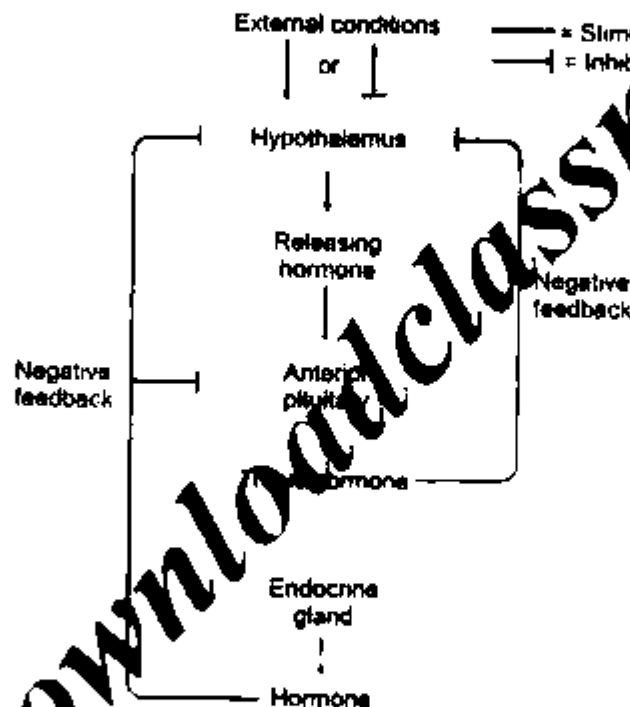
Ans: Feedback Mechanisms Endocrine glands

Endocrine glands do not secrete their hormones at a constant rate. The rate varies with the needs of the body. Like many other functions in body, the secretion of hormones is also regulated by feedback mechanisms. Feedback mechanism means the regulation of a process by the output of the same process.

Types of Feedback Mechanisms

Feedback mechanisms are of two types i.e. positive and negative feedbacks.

Negative Feedback Mechanisms

The output of a process decreases or inhibits the process. This mechanism works to return a condition towards its normal value. For example, when the blood glucose concentration rises, pancreas secretes insulin. It decreases the blood glucose concentration. Decline in the blood glucose concentration to a normal set-point inhibits the secretion of insulin. Similarly, when blood glucose concentration drops below normal, pancreas secretes glucagon. It raises the blood glucose concentration. In this case, rise in the blood glucose concentration to a normal set-point inhibits the secretion of glucagon. In other words, the blood glucose concentration (output) controls the process i.e. the secretion of insulin and glucagon.

Positive Feedback Mechanisms

In positive feedback, the changes resulting from a process increase the rate of process. For example, suckling action of an infant stimulates the production of a hormone in mother. This hormone works for the production of milk. More suckling leads to more hormone, which in turn leads to more milk production.

Q. What are the disorders of Nervous System?

Ans. DISORDERS OF NERVOUS SYSTEM

Disorders of nervous system can be categorized into two main types i.e. vascular disorders e.g. paralysis and functional disorders e.g. epilepsy. Vascular disorders are due to any disturbance in the blood supply to nervous system while functional disorders are due to disturbance in nerve impulse generation and transmission.

Paralysis is the complete loss of function by one or more muscle groups. It is most often caused by damage to the central nervous system (brain or spinal cord).

Causes of Paralysis

The damage may be due to stroke (rupture in a blood vessel of brain or spinal cord), blood clotting in these blood vessels or poison produced by polio viruses.

Symptoms of Paralysis

Patient may have weak paralysis throughout his / her body or have paralysis on one side of body. There may also be paralysis in the lower extremities or in all four limbs.

2. Epilepsy

Epilepsy is a nervous disorder in which there is abnormal and excessive discharge of nerve impulses in brain. It causes unprovoked seizures in patient.

Convulsions

A seizure of epilepsy is a temporary abnormal state of brain marked by convulsions.

Causes of Epilepsy

In younger people, epilepsy may be due to genetic or developmental causes. In people over age 40 years, brain tumours are more likely to cause epilepsy. Head trauma and central nervous system infections may cause epilepsy at any age.

Measures against Epilepsy

There is no known cure of epilepsy but medicines can control seizures. Patients of epilepsy have to take medicines daily for the treatment as well as prevention of seizures ... are termed "anti convulsant" or "anti epileptic" drugs.

Important Information

During a seizure attack, objects should never be placed in a patient's mouth as it can result in serious injury. It is possible that the patient will bite his/her own tongue.
The knowledge of the composition and functioning of nervous system has helped man in the diagnosis and treatment of nervous disorders including paralysis and epilepsy. Man has discovered the areas of brain that receive information from different sense organs and the areas that send messages to different effectors. Such knowledge helps a lot in identifying the malfunctioning areas of brain.

SUPPORT AND MOVEMENT

Major Concepts:

13.1- Human Skeleton
13.2- Types of Joints
13.3- Muscles and Movement
13.4- Disorders of Skeletal System

Q.1: Define Support and Movement. Give its examples.

Ans: Support:

The organisms with greater sizes need support to keep their body mass as one unit. This is particularly true for the organisms that live on land.

Movement

The movement and locomotion are characteristics of animals. "Movement" is a general term meaning the act of changing place or position by entire body or by its parts. There are two types of movements i.e

Example

Movements of body parts and locomotion. Locomotion is the movement of an animal as a whole from one place to another.

Q.2: Define Human Skeleton? Give its types.

Ans: HUMAN SKELETON:

Skeletal system or skeleton is defined as the framework of hard, articulated structures that provide physical support, attachment for skeletal muscles, and protection for the bodies of animals.

Endoskeleton: Like other vertebrates, the human skeleton is on the inside of body and is called endoskeleton. In the living body, the skeleton is very much alive.

Example

Bones and cartilages are made of living cells and also have nerves and blood vessels in them. They grow and have the ability to repair themselves.

Exoskeleton

The skeletal system of some invertebrates e.g. arthropods, is on the outside of the body, and is called exoskeleton.

Q.3: What is the role of Skeletal System? And give the Structure of Human Skeleton.

Ans: Role of Skeletal System:

(i) The big functions of skeletal system are protection, support and movements.

(ii) In our body, skeleton works very closely with the muscular system to help us move.

(iii) Similarly, skeleton provides protection to many internal organs e.g. skull protects brain, vertebral column protects spinal cord and ribs protect most of our other internal organs.

(iv) Vertebral column also provides the main support to our body mass.

Structure of Human Skeleton:

Bone and Cartilage:

Overall, the human skeletal is made of bony framework but in certain parts, this framework is supplemented by cartilage.

(a) Cartilage:

Cartilage is a dense, clear blue-white firm connective tissue (but less strong than bone).

Chondrocytes

The cells of cartilage are called chondrocytes

Lacuna

Each chondrocyte lies in a fluid space called lacuna present in the matrix of cartilage

Collagen Fiber

The matrix of cartilage contain also collagen fibres.

Blood vessels do not enter cartilage. There are three types of cartilage

Hyaline cartilage: is strong yet flexible. It is found covering the ends of the long bones, in the nose, larynx, trachea and bronchial tubes.

Elastic cartilage: is similar in structure to hyaline cartilage. It is also quite strong but has elasticity due to a network of elastic fibres in addition to collagen fibres. It is found in epiglottis, pinna etc.

Fibrous cartilage: is very tough and less flexible due to large number of thick collagen fibres present in knitted form. It is found in intervertebral discs.

(b) Bone:

Bone is the hardest connective tissue in body. Bones not only move, support and protect the various parts of body but also produce red and white blood cells and store minerals.

Compact Bone: The hard outer layer of a bone is called compact bone.

spongy bone: The interior bone is soft and porous its called spongy bone. Spongy are contains blood vessels and bone marrow.

Osteocytes: On the other hand, bones contain different types of cell. The mature bone cells are called osteocytes.

Important Information

1. ***Cartilage and bone are** types of connective tissue in animals. Most connective tissues contain collagen fibres in a matrix.*
2. *Tendons and ligaments are other connective tissues that contain tightly packed collagen fibres*
3. *Andreas Vesalius (1514-1564) is honoured for developing modern anatomical*

studies. Vesalius was born in Brussels. Belgium. He made many discoveries in anatomy, based on studies made by dissection of human dead bodies His book contained the most accurate depictions of the whole skeleton and muscles of the human body.

Q.4: What are components of Human Skeleton?

Ans: Components of Human Skeleton:

The 206 bones in the adult human skeleton are organized into a longitudinal axis i.e. axial skeleton, to which appendicular skeleton is attached.

(a) Axial skeleton:

Axial skeleton consists of the 80 bones in the head and trunk of body. It is composed of five parts

Skull

Skull contains 22 bones out of which 8 are cranial bones (enclosing the brain) and 14 are facial bones.

Middle Ear Ossicles

There are 6 middle ear ossicles (3 in each ear).

Neck

There is also a hyoid bone in neck.

Vertebral Column

Vertebral column contains 33 bones (vertebrae).

Sternum

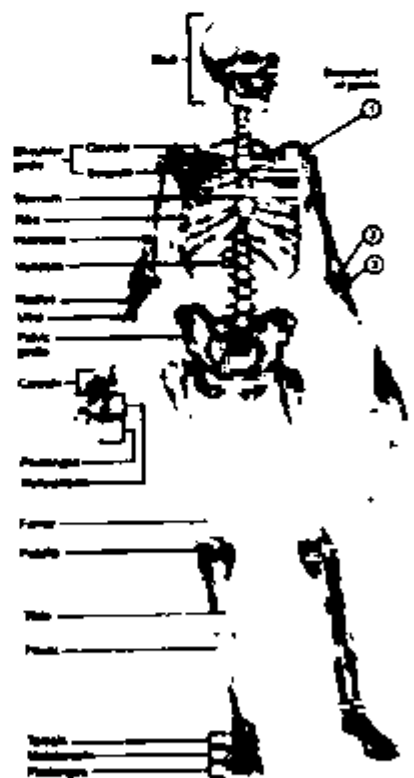
The chest is made of a chest bone called sternum and 24 (12 pairs) ribs.

(b) Appendicular Skeleton:

Appendicular skeleton is composed of 126 bones. Pectoral (shoulder) girdle is made of 4 bones. Arms have 6 bones. Both hands have 56 bones. Pelvic girdle (hips) has 2 bones. Legs have 8 bones. Both feet have 56 bones.

The Human Skeletal system

Important Information

The upper jaw is fixed with the skull and is composed of two bones. The lower jaw is mobile and articulates with the skull. In lower vertebrates, the lower jaw is made up of more than one bone while in mammals, it is made of single bone During evolution, mammals modified the lower jaw bones

and incorporated four of them into the middle ear (in the form of malleus and incus in both ears) This adaptation proved beneficial for mammals. Lower jaw with single bone is stronger and the malleus and incus also improve hearing.

Q.5: What are Types of Joints?

Ans: Types of Joints:

A joint is the location at which two or more bones make contact. They allow movement and provide mechanical support. Joints can be classified on the basis of the degree of movement they allow.

Immoveable (Fixed) Joints: Such joints allow no movement e.g. the joints between the skull bones.

Slightly moveable joints: Such joints allow slight movements e.g. joints between the vertebrae.

Ball and socket joint

Moveable Joints

They allow a variety of movements e.g. shoulder joint, hip Joint, elbow joint, knee joint etc. There are many types of moveable joints in body The main types are hinge joints and ball-and-socket joints.

Hinge joint

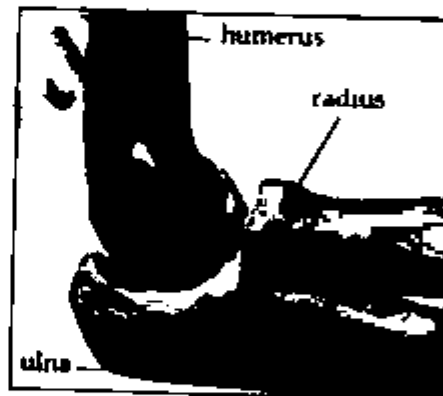
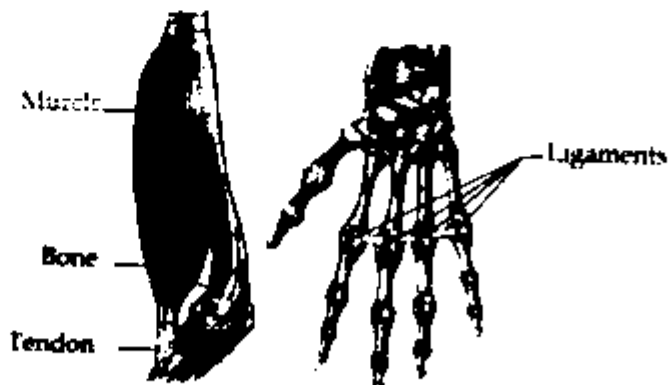
Hinge Joints

Hinge joints move back and forth like the hinge on a door and allow movements in one plane only. The knee and elbow are hinge joints.

Ball-and-Socket

Ball-and-socket joints allow movement in all directions. The hip and shoulder joints are ball-and-socket joints

Roles of Tendons and Ligaments

Tendons and ligaments are bands of connective tissue (made of collagen). Tendons are tough bands and attach muscles to bones. When a muscle contracts tendon exerts a pulling force on the attached bone, which moves as a

result. Ligaments are strong but flexible bands and join one bone to another at joints. They prevent dislocation of bones ad-joints.

Q.6: Explain the Muscles and its Movements.

Ans: MUSCLES AND MOVEMENT:

When bones move at joints, they produce movements. The movements in bones are brought about by the contractions of skeletal muscles, which are attached with them by tendons. The role of skeletal muscles is as follows.

Origin

One end of a skeletal muscle is always attached with some immoveable bone. This end of muscle is called the origin.

Insertion

Other end of muscle is attached with a moveable bone and is called the insertion. When a muscle is stimulated by a nerve impulse, it contracts to become shorter and thicker. Due to this contraction, it pulls the moveable bone (at insertion).

Antagonists

Skeletal muscles are usually in pairs of antagonists. In an antagonistic pair, both muscles do opposite jobs.

Antagonism

When one muscle contracts the other relaxes and this Phenomenon is known as antagonism (antagonistic action).

Flexor and Flexion

When a muscle contracts and bends the joint, it is known as flexor muscle and the movement is called flexion.

Extensor and Extension

When a muscle contracts and straightens the joint, it is known as extensor muscle and the movement is called extension. Following is an example of the antagonistic action of a Pair of skeletal muscles.

Biceps and Triceps

Biceps is a flexor muscle on the front of the upper arm bone while Triceps is an extensor muscle on the back of arm. Both these muscle have their origin at pectoral girdle and insertion at one of the two bones of forearm.

Mechanism of Movement

When biceps contracts, the forearm (insertion end) is pulled upward. It is the flexion of elbow joint. During this flection, triceps muscle relaxes. When triceps muscle contracts, forearm is pulled down. It is the extension at elbow joint. During it, biceps muscle relaxes

In this way, biceps and triceps make up an antagonistic pair of muscles. Similar pairs, working antagonistically across other joints, provide for almost all the movements of skeleton.

Q.7: WHAT ARE THE DISORDER OF SKELETAL SYSTEM?

Ans: DISORDERS OF SKELETAL SYSTEM:

The following disorders of skeletal system.

1. Osteoporosis:

Osteoporosis is a bone disease in adults, especially in old people. It is more common in old women. In osteoporosis, there is a decrease in the density of bones due to loss of calcium and phosphorus.

Cause of Osteoporosis

It may be due to malnutrition (lack of proteins and Vitamin C), lack of physical activities or deficiency of estrogen hormone. In old age, there is decreased secretion of growth hormones and it also leads to decreased.

2. Arthritis

Arthritis means "inflammation in joints". It is also very common in old age and in women.

Symptoms of Arthritis

It is characterized by pain and stiffness in joints (particularly in the weight bearing joints e.g. hip joint, ankle joint etc.). The treatment of arthritis includes pain killer and anti-inflammatory medicines.

Example There are many types of arthritis.

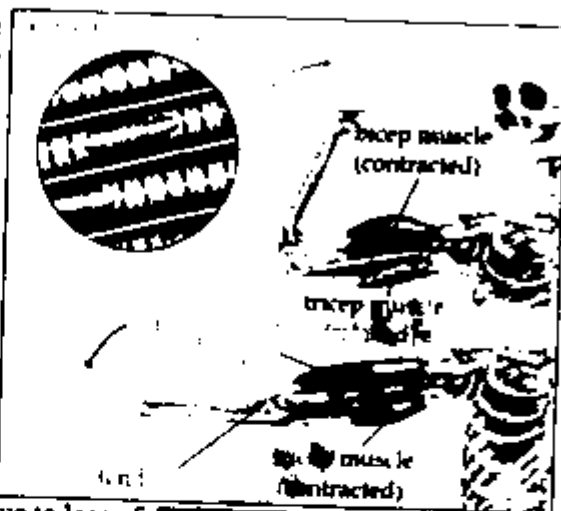
(i) Osteoarthritis:

It is due to degeneration in the cartilage present at joints or due to decreased lubricant production at joints. In this arthritis, fusion of the bones at joint may occur and joints may become totally immoveable.

(ii) Rheumatoid arthritis:

It involves the inflammation of the membranes at joints. Its symptoms include fatigue, low-grade fever, pain and stiffness in joints.

(iii) Gout:

It is characterised by the accumulation of uric acid crystals in moveable joints. It generally attacks the toe joints.

14 REPRODUCTION

Major Concepts:

14.1- Reproduction
14.2- Methods of Asexual Reproduction
14.3- Sexual Reproduction in Plants
14.4- Sexual Reproduction in Animals

Q.1: Define Reproduction and give its types.

Ans: Reproduction:

Reproduction is defined as the production of individuals of the same species i.e. the next generation of species.

Fundamental Characteristics

It is one of the fundamental characteristics of living things, it is not an essential life process.

Continuation of Species

Reproduction is thus essential for the continuation of species. It ensures that the genetic material of one generation is transmitted to the next.

Production of offsprings

Each generation produces more offsprings for the next generation. Many individuals die due to various reasons like diseases, competition, genetic factors etc. before reaching the reproductive age.

Advantageous

Only the fittest and the best survive and reach the reproductive age. This ensures that the advantageous characteristics are transmitted to the next generation.

Types of Reproduction

There are two types of Reproduction.

(i) Asexual reproduction:

Asexual reproduction means simple cell division that produces an exact duplicate of an organism. There are many types of asexual reproduction which we shall discuss on the following pages.

(ii) Sexual reproduction:

Sexual reproduction involves the joining (fusion) of male and female sex cells i.e. gametes

Q.2: Explain the various Methods of Asexual Reproduction.

Ans. Methods of asexual reproduction:

Asexual reproduction does not involve the fusion of gametes.

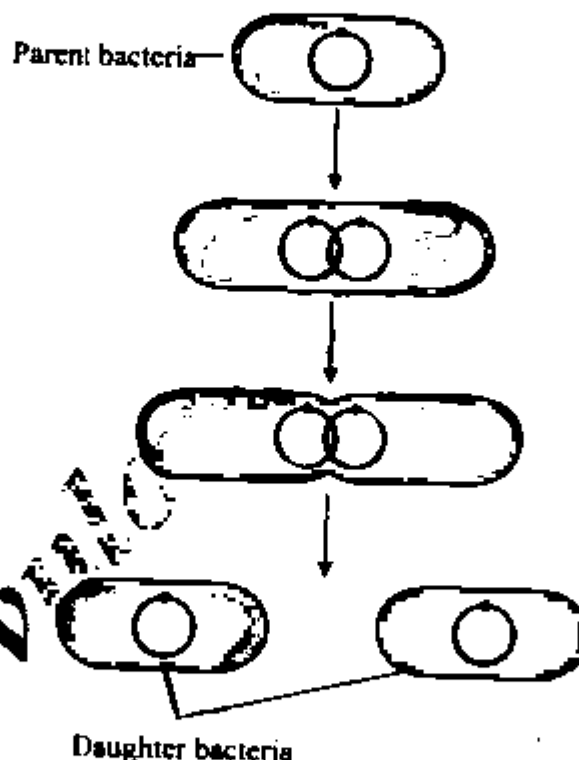
Types of Asexual Reproduction

There are many types of asexual reproduction, all producing individuals that are genetically identical to each other and to the parent.

1. Binary Fission:

Binary fission means "division into two". It is the simplest and most common method of asexual reproduction. It occurs in prokaryotes (bacteria), many unicellular eukaryotes e.g. protozoa and some invertebrates.

Binary Fission in Bacteria

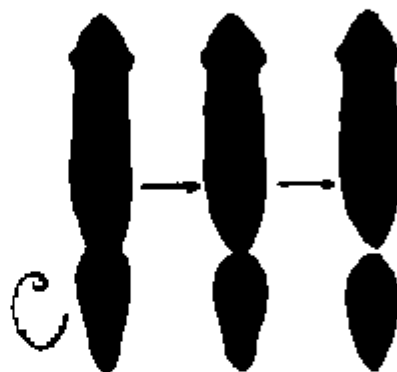
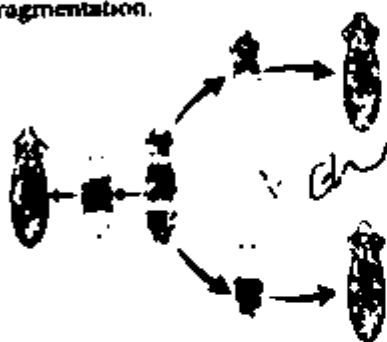
During binary fission in bacteria, the DNA is duplicated and so two copies of DNA are formed. The two copies move towards the opposite poles of cell. The cell membrane invaginates in centre and divides the cytoplasm into two. New cell wall is deposited between two cross membranes. It results in the formation of two daughter bacteria, which grow in size and divide again.

Binary Fission in Unicellular Eukaryotes

During binary fission in unicellular eukaryotes, the nucleus of parent organism divides into two (by mitosis). It is followed by the division of cytoplasm.

So two daughter cells of almost equal size are formed. Daughter cells grow in size and then divide again.

Important Information

Some unicellular organisms (e.g. Amoebae) form hard walls called cysts around them, under unfavourable conditions. When favourable conditions return, the nucleus of parent divides into many daughter nuclei by repeated divisions. This is followed by the division of cytoplasm into several parts. Each new part of cytoplasm encloses one nucleus. So a number of daughter cells are formed from a single parent at the same time. This kind of fission is known as multiple fission.

2. **Fragmentation:** As certain worms grow to full size, they spontaneously break up into 8 or 9 pieces. Each piece (fragment) develops into a mature worm, and the process is repeated. If a planarian breaks into many pieces instead of two, it will also be called as fragmentation.

3. **Budding:**

In this type of asexual reproduction, a bud develops as a small outgrowth on parent's body. In case of yeast (a unicellular fungus) a small bud is formed on one side of cell.

The nucleus of cell divides and one of the daughter nuclei is passed into the bud. Parent cell may form more than one bud at a time. Each bud enlarges and develops the characteristics of parent organism.

The bud may separate from parent body. In some cases, the buds never separate and as a result, colonies of individuals are formed.

Budding in Hydra

Animals such as sponges, *Hydra* and corals also reproduce by means of budding. In them, a small bud is formed on the side of body, by mitosis. This bud enlarges by the formation of more cells. It then detaches from the parent body and grows into new organism.

In corals, the buds do not detach from the parent body. Corals form big colonies, because the buds grow into new organisms by remaining attached to the parent body In corals, the buds do not detach from the parent body. Corals form big colonies, because the buds grow into new organisms by remaining attached to the parent body.

4. Spore Formation:

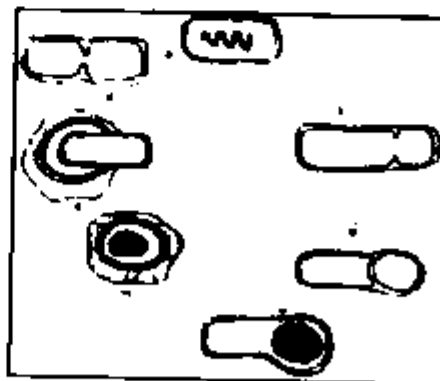
It is generally seen in most fungi (e.g. *Rhizopus*). When *Rhizopus* reaches reproductive age, its body cells form thick walled spore sacs called sporangia (*single*, sporangium).

Spore:

Inside each sporangium, a cell divides many times and forms many daughter cells called spores.

Cyst

Each spore is covered with a thick wall called cyst and it can survive un favourable conditions. When sporangia are mature, they burst and release spores. Under favourable conditions, the spores germinate and develop into new *Rhizopus*

Under unfavourable conditions, some species of bacteria reproduce by forming spores, e.g. *Clostridium* and *Bacillus* species. The bacterial spores are also thick-walled. They are formed inside bacterial cells, so are called endospores

5. Parthenogenesis

Parthenogenesis is also considered as a form of asexual reproduction. In it, an unfertilized egg develops into new offspring. Some fishes, frogs and insects reproduce by means of parthenogenesis. Similarly, queen honeybee lays eggs in the cells of honeycomb. Many eggs remain unfertilized and develop into haploid males (drones) by parthenogenesis. At the same time, some eggs are fertilized by male bees and these develop into diploid females (new queen and worker bees).

6. Vegetative Propagation

When vegetative parts of plants i.e. roots, stems or leaves give rise to new plants, the process is called vegetative reproduction or vegetative propagation. It occurs naturally, and can also be brought about artificially.

Q.3: What are various methods of Natural Vegetative Propagation?

Ans: Natural Vegetative Propagation:

Vegetative propagation occurs naturally in several ways.

Bulbs are short underground stems surrounded by thick, fleshy leaves that contain stored food. Adventitious roots emerge under the base of bulb while shoots emerge from the top of the base. Tulips, onions and lilies reproduce by bulbs

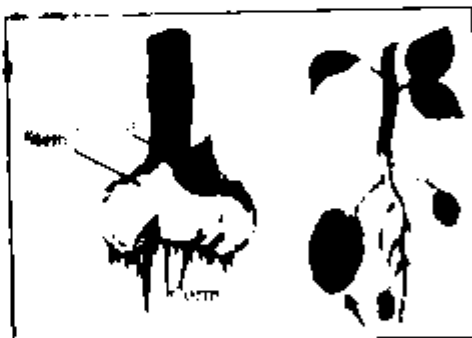
Corms are short and swollen underground stems containing stored food. Buds are present at the top of corm. From a bud, shoot grows and forms a new plant. Dasheen and garlic reproduce by corms.

Rhizomes are horizontal underground stems with scale leaves. There are enlarged portions called nodes on rhizome. Buds are produced at nodes. The buds present on the upper surface of rhizome give rise to shoot. The lower surface of rhizome produces adventitious roots. Ginger, ferns and water lilies reproduce by rhizomes.

Stem Tubers are the enlarged portions of an underground stem (rhizome). There are aggregations of the buds in the form of "eyes" along the surface of tuber. Each bud develops into shoot that grows upward and also produces roots. Potatoes and yams reproduce by tubers.

Under ground stems

Suckers are lateral stems close to ground level. A sucker grows underground form some distance and then turns up, producing the new plant. Mint and *Chrysanthemum* reproduce in this way.

Vegetative propagation by leaves is not common and is seen in plants such as

Bryophyllum (Pather chut). This plant has fleshy leaves and adventitious buds are present at the margins of leaves. When leaf falls on ground, the buds grow into new plants.

Q.4: What is Artificial Vegetative Propagation?
Ans: Artificial Vegetative Propagation:

Gardeners and farmers use artificial methods of vegetative propagation to increase the stock of a plant. The following two are the most common methods of artificial vegetative propagation

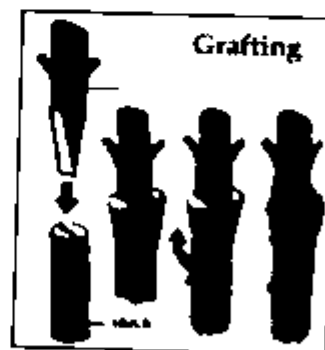
1. Cuttings:

In this method, cuttings may be taken mainly from the stems or roots of parent plant. These cuttings must have a meristematic region from which growth can occur. When cuttings are placed in a suitable soil and under right conditions (sufficient nutrients, water and sunlight), they form roots and shoots. Roots and shoots grow and develop into a plant identical to the parent plant from which the cuttings were taken. Roses, ivy and grapevines are propagated by stem cuttings.

Sweet potato is an enlarged root. Farmers place it in moist sand or soil until it produces several plant lets. Then the plant lets are removed and planted.

This process is used to produce many plants from a single plant. All new plants are exactly the same. This artificial vegetative propagation has been very beneficial on sugarcane plantation.

2. Grafting:

In grafting, a piece of stem is cut from the plant and is attached with another plant with established root system. After a while, the vascular bundles of the attached stem piece and the host plant are connected to each other. The stem piece and the plant begin to grow together. This method is used to propagate many roses, peach trees, plum trees and various seedless fruits (including grapes).

Q.5: What are Advantages and Disadvantages of Vegetative Propagation of Plants?
Ans: Advantages and Disadvantages of Vegetative Propagation of Plants:

Plants can reproduce asexually via vegetative propagation. This method of reproduction has some advantages and disadvantages as well.

1. **Advantages:**

(a) The offsprings produced through vegetative propagation are genetically identical. Therefore beneficial characteristics can be preserved. In vegetative propagation, there is no need of any mechanism of pollination

(b) It helps to increase number of plants at a rapid rate. The organs of vegetative propagation enable many plants to pass over unfavourable conditions. Plants bearing seedless fruits can be grown only by vegetative propagation.

2. **Disadvantages:**

The plants do not have genetic variations. Species specific diseases can attack and this can result in the destruction of an entire crop.

Q.6: What is Tissue Culture and Cloning?

Ans: Tissue Culture and Cloning:

Cloning

Cloning is the latest method of vegetative propagation. In this method, identical offsprings are produced from a single parent using its vegetative tissue or cell. Tissue culture is the technique applied in this method.

Tissue Culture

Tissues are taken from any part of plant and are put in a suitable nutrient medium. The tissue cells start mitosis and produce masses of cells called calluses are transferred to other medium that contains different hormones for the formation of roots, stem and leaves. Calluses make these structures and grow into new small plants. The small plants are then planted in pots and then in fields.

Q.7: HOW SEXUAL REPRODUCTION OCCURS IN PLANTS?

Ans: SEXUAL REPRODUCTION IN PLANTS:

Sexual reproduction involves the production of gametes (sperms and egg cells) and their fusion i.e. fertilization. Gametes are produced in special structures in plant body.

Example

The major plants groups are mosses, ferns and seed plants. The seed plants include gymnosperms and angiosperms (flowering plants). Plant groups use different methods for bringing the sperm and egg cells together. In mosses and ferns sperms are motile and can swim to egg cells. Therefore, these plants require water (in the form of dew or rain) for sexual reproduction. On the other hand, gymnosperms and angiosperms have special methods for carrying their sperms to egg cells. They do not need water for reproduction.

Life Cycle

Sporophytic Generation: In the life cycle of plants, two different generations alternate with each other

Gametophytic Generation: One generation is diploid and produces spores. It is called sporophyte generation. The other generation is haploid and produces gametes. It is called gametophyte generation.

Alternation of Generation

The phenomenon in which two different generations alternate with each other during life cycle is known as alternation of generations.

In most plants, sporophyte generation is dominant. It means that it is big in size and is independent. Sporophyte produces haploid spores by meiosis. The spores develop into gametophyte. It is small in size and depends upon sporophyte. It produces gametes by mitosis. The male and female gametes fuse and form diploid zygote. The zygote undergoes repeated mitosis and develops into a new diploid sporophyte

Q.8: How Sexual Reproduction In Flowering Plants Occurs?

Ans: Sexual Reproduction in Flowering Plants

In angiosperms, parent plant is diploid sporophyte generation. Flower is the reproductive structure in this generation. The flower components are arranged in the form of whorls. The outer two whorls in a flower are the non-reproductive whorls while the inner two whorls are the reproductive whorls.

Structure of Flower:

(i) Calyx:

Calyx is the outermost whorl. It usually green in colour. Its individual units (leaflets) are called sepals. Sepals protect the inner whorls at bud stage.

(ii) Corolla:

Corolla is the next inner whorl and is often coloured brightly. Its individual units (leaflets) are called petals. They serve to attract bees, birds, etc. which are the agents of pollination.

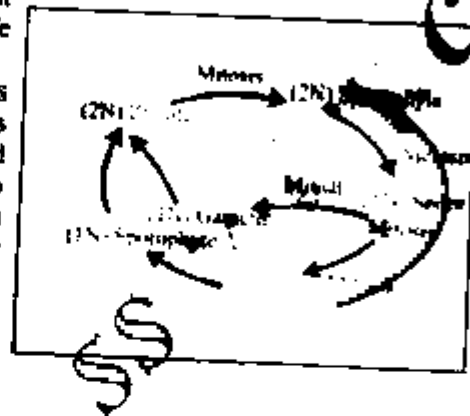
(iii) Androecium:

Third whorl i.e. androecium is the male reproductive part of flower. Its units are called stamens.

(a) Anther:

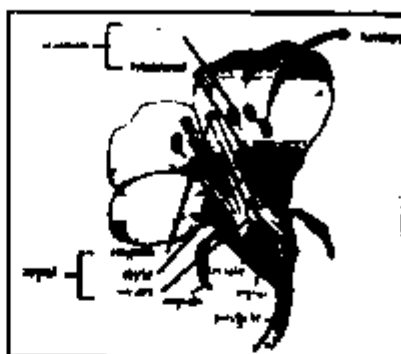
Each stamen has a thread-like filament at the free end of which anther is attached. Anther has pollen-sacs in which haploid microspores (pollen grains) are produced through meiosis. Each microspore germinates into the male gametophyte generation.

(b) Generative Nucleus:

During it, the nucleus of microspore undergoes mitosis and produces two nuclei i.e. a tube nucleus and a generative nucleus.

(c) Sperm:

The generative nucleus again undergoes mitosis and produces two sperms. So, a germinated microspore has a tube nucleus and two sperms. All these structures are the male gametophyte generation of plant.

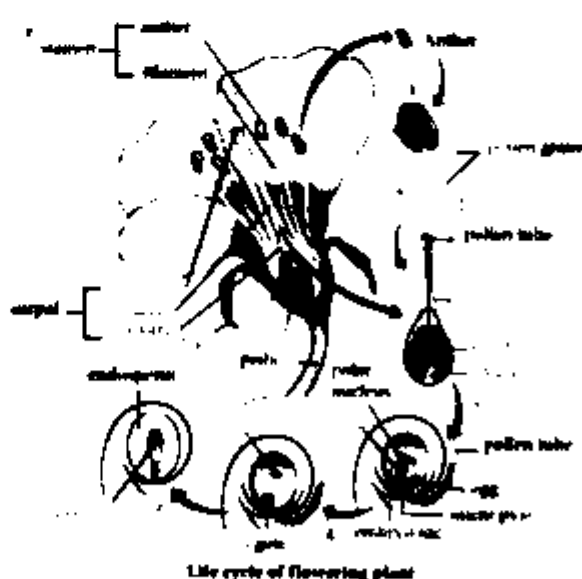
(iv) Gynoecium:

Fourth whorl i.e. gynoecium is the female reproductive part of flower. Its units are called carpels (or pistils). Each carpel is made up of the basal ovary, middle style and upper stigma. Inside ovary, there are one to many ovules. Inside each ovule, one haploid macrospore is produced through meiosis. Macrospore germinates into the female gametophyte generation. During it, macrospore undergoes mitosis and produces an egg cell and some associated structures (e.g. fusion nucleus). Egg cell and associated structures are the female gametophyte generation of plant.

Pollination

When pollen grains mature, they are transferred to stigma. It is called pollination on reaching the stigma, the tube nucleus of pollen grain constructs a pollen tube The pollen tube contains a tube nucleus and two sperms. The tube grows through style and ovary and enters ovule. Here, it bursts and releases the sperms. Both sperms enter the female gametophyte. One sperm fuses with egg and forms a diploid zygote.

Double Fertilization

Life cycle of flowering plant

Sperm fuses with diploid fusion nucleus and forms a triploid (3N) nucleus called endosperm nucleus. Since the process of fertilization involves two fusions, it is called double fertilization. Zygote develops into embryo and endosperm nucleus develops into endosperm tissue (food of the growing embryo). Ovule then becomes seed and ovary changes into fruit. When seeds mature, they are dispersed (we shall discuss in the next section). If seeds get suitable conditions, their embryos develop into new plants (the diploid sporophytes of the next generation).

Q.9: Define Pollination, give its types.

Ans: Pollination:

Pollination is defined as the transfer of pollen grains from flower's anther to stigma.

Types of Pollination

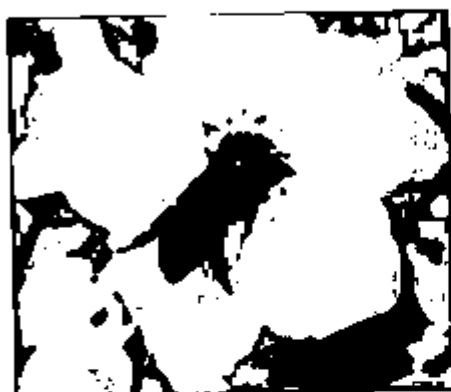
Two types of pollination are recognized.

(i) **Self pollination** is defined as the transfer of Pollen grains from the anther to the stigma of the same flower or other flower of the same plant.

(ii) **Cross pollination** is the transfer of pollen grains from the flower on one plant to the flower on other plant of the same species. Cross pollination is brought about by various agencies like wind, water, bees, birds, bats and other animals including man. The insect pollinated and wind pollinated flowers have structural adaptations that facilitate the transfer of pollen grains between two plants.

Adaptations in insect-pollinated and wind-pollinated flowers		
Feature	Insect Pollinated Flowers	Wind Pollinated Flowers
Size	Generally large	Generally small
Colour	Petals brightly coloured	Petals green or dull in colour
Nectar	Produce nectar	Do not produce nectar
Floral arrangement	Flowers face upwards	Flowers hang down for easy shaking
Stamens and stigmas	Enclosed inside ring of petals	Hang out of ring of petals
Pollen grains	Small number produced heavy and sticky	Large number produced / light with smooth surface
Stigma	Pinhead shaped with no branches	Feathery branches for catching pollen

Example

Examples of insect pollinated flowers are buttercup, rose, wallflower, sunflower, orchid etc. Examples of wind pollinated flowers are grasses, hazel, willow, corn etc.

Q.10 Write a note on Development and Structure of Seed.

Ans. Development and Structure of Seed:

After fertilization in the female gametophyte, zygote divides repeatedly by mitosis and develops into an embryo. At this stage (in gymnosperms and angiosperms), ovule changes into seed. The formation of seed completes the process of sexual reproduction in seed plants.

Parts of Angiosperm

Angiosperm seeds consist of three distinct parts:

(1) The embryo formed from zygote.
(2) The endosperm tissue formed from endosperm nucleus.
(3) The seed coat which develops from the wall of ovule (integument).

Seed Coat

Seed coat (or testa) develops from the integument, originally surrounding the ovule. It may be a paper-thin layer (e.g. peanut) or thick and hard (e.g. coconut). Seed coat protects embryo from mechanical injury and from drying out.

There is a scar on seed coat, called hilum. It is where the seed is attached to ovary wall (fruit). At one end of hilum, there is micropyle. This is the same opening through which the pollen tube entered ovule. Seed uses it for the absorption of water

Example

Examples of insect pollinated flowers are buttercup, rose, wallflower, sunflower, orchid etc. Examples of wind pollinated flowers are grasses, hazel, willow, corn etc.

Formation of Root:

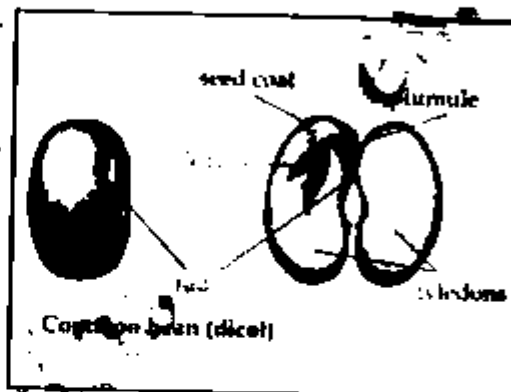
Embryo is actually an immature plant. It consists of a radicle, a plumule and one or two cotyledons (seed leaves). The radicle of embryo develops into new root.

Formation of Shoot:

The plumule develops into new shoot. The embryonic stem above the point of attachment of cotyledon(s) is called epicotyl.

Common bean (dicot)

Hypocotyl

The embryonic stem below the point of attachment is hypocotyl. Within seed, there is a store of nutrients for the seedling that will grow from embryo. In angiosperms, the stored food is derived from the endosperm tissue. This tissue is rich in oil or starch and protein. In many seeds, the food of the endosperm is absorbed and stored by cotyledons.

Q.11: What is Germination of Seed?

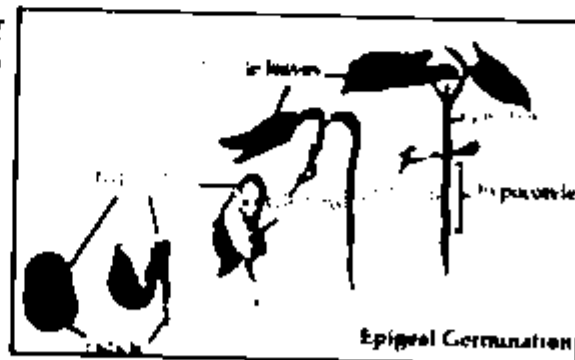
Ans: Germination of Seed:

For the germination of seeds, they must arrive at time favourable for germination and growth.

Seed germination is a process by which a seed embryo develops into a seedling. During germination, embryo soaks up water which causes it to swell, splitting the seed coat. Root is the first structure that emerges from the radicle present in seed. It grows rapidly and absorbs water and nutrients from soil. In the next phase, plumule develops into tiny shoot which elongates and comes out of soil

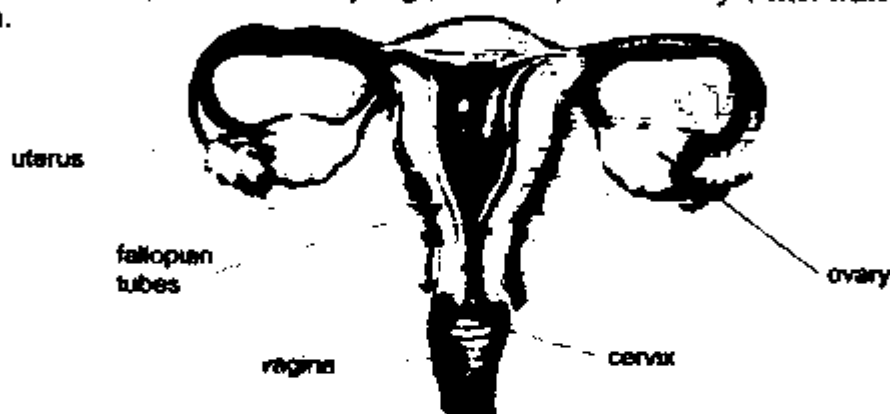
On the basis of the elongation of hypocotyl and epicotyl, there are two types of germination

In epigeal germination, the hypocotyl elongates and forms a hook, pulling the cotyledons above ground. Beans, cotton and papaya are the examples of seeds that germinate this way

Epigeal Germination

Formation of Zygote

Sperms swim through cervix and uterus to fallopian tubes where they fertilize the egg cells, released from ovary. After fertilization, zygote is carried to uterus. By this time, the zygote has started dividing and is now called embryo. The embryo is implanted in uterus walls.

Placenta

A connection, called placenta, is established between embryo and uterus wall. Embryo develops into new offspring (rabbit kit) in 30-32 days, after which it is born.

Q.16: What is Growth in Human Population and its Consequences?

Ans. Growth in Human Population and its Consequences:

Pakistan's population in the year 2007.-2008 was 163,775,000. By the end of this decade, our population is expected to exceed 176 million. Pakistan's population had a relatively high growth rate in past.

When population growth exceeds the carrying capacity of an area or environment, it results in overpopulation. Many problems are associated with human overpopulation. The overpopulated areas face severe shortage of fresh water and natural resources. Overpopulation results in deforestation and loss of ecosystems. It leads to more pollution and global warming. There is high infant and child mortality rate in overpopulated areas due to poverty. Overpopulation raises demands for more housing units, more hospitals, more jobs, more educational institutions, increase in food crops etc.

People should be educated about the problems of overpopulation. Pakistan's Ministry of Population Welfare has taken a number of steps to make people aware of the hazards of overpopulation and to stabilize the population to match our resources.

Q.17: Write a note on Sexually Transmitted Disease AIDS.

Ans: AIDS: A Sexually Transmitted Disease:

Sexually Transmitted Diseases (STDs) are defined as the diseases that are transmitted through sexual act. The most serious and challenging health problem faced by the world today is AIDS.

HIV

It is also a sexually transmitted disease. AIDS stands for Acquired Immuno Deficiency Syndrome. It is caused by human immuno deficiency virus (HIV). The virus destroys white blood cells, which results in loss of resistance against infections. It is a fatal disease. It spreads through transfer of body fluids such as blood and semen.

Causes of AIDS

Thus the main causes are unprotected sexual activities, use of infected needles or transfusion of infected blood

Q.18: What is role of NACP and NGOs in AIDs control?

Ans: Organizations (NGOs)

Pakistan's Federal Ministry of Health established NACP in 1987. The main objective of this programme is to help the public for the prevention of HIV transmission, safe blood transfusions and reduction of STDs.

HIV Infection in Pakistan

The frequency of HIV infection in Pakistan is still low. But, the country is at risk of epidemic due to various risk factors e.g. exposure to infected blood or blood products, homo-sex, and injecting drug users. For improved prevention by the general public, the NACP started services through TV and radio channels and print media in 2005.

Objectives

The objectives of this activity were to:

(i) Change public attitude for safe sexual activities,
(ii) Create demand for information on HIV and AIDS, and
(iii) Improve attitudes and behaviour among healthcare workers

Role of Government

According to the latest data by the World Bank, at least 54 NGOs are working in Pakistan for HIV/AIDS public awareness and for the care and support of persons living with HIV/AIDS. These NGOs also work on AIDS education and prevention for sex workers and other high-risk groups. NGOs serve as members of the Provincial consortium on HIV/AIDS, which has been set up in all the provinces of Pakistan.

INHERITANCE

Major Concepts:

15.1- Introduction to Genetics
15.2- Chromosomes and Genes
15.3- Mendel's Laws of Inheritance
15.4- Co-dominance and Incomplete Dominance
15.5- Variations and Evolution

Q.1: Define Genetics and give its characteristics.

Ans: Genetics:

Genetics is the branch of biology in which we study inheritance.

Inheritance

Inheritance means the transmission of characteristics from parents to offspring.

Traits

The characteristics of organisms are called the traits.

Example

In man height, colour of the eyes, intelligence etc. are all inheritable traits.

Transmission of Characteristics

Parents pass characteristics to their young through gene transmission. Equal numbers of chromosomes from each parent are combined during fertilization.

The chromosomes carry the units of inheritance called the genes.

Q.2: Write a note on Chromosomes and Genes.

Ans: Chromosomes and Genes:

Working of the Genes

Genes consist of DNA. They contain specific instructions for protein synthesis.

Homologous Chromosome

The body cells have a constant number of paired chromosomes. The two chromosomes of a pair are known as homologous chromosomes. In humans body cells, there are 23 pairs of homologous chromosomes for a total of 46 chromosomes. We may recall that during meiosis, the two members of each chromosome pair separate and each of them enters one gamete.

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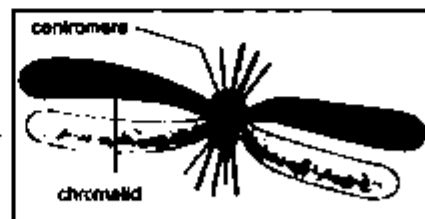
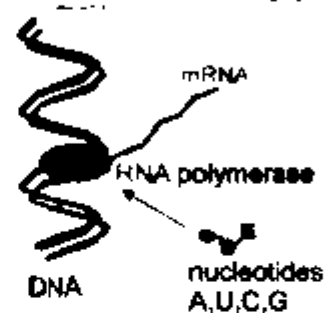
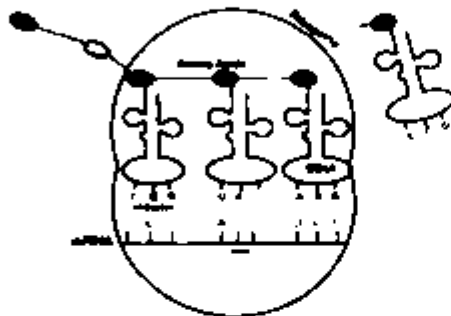

Chromatin

Chromosome is made of chromatin material (simply as chromatin). Chromatin is a complex material, made of DNA and proteins (mainly histone proteins).

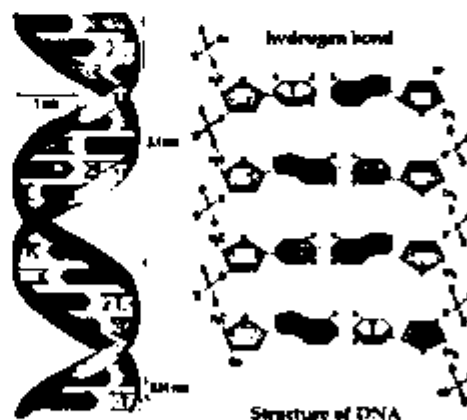
Nucleosomes

DNA wraps around histone proteins and forms round structures, called nucleosomes. DNA is also present between nucleosomes. In this way, the nucleosomes and the DNA between them look like "beads on a string" (Fig. 15.1). The fibres consisting of nucleosomes condense into compact forms and get the structure of chromosomes.

Q.3: What is Watson-Crick Model of DNA?

Ans: Watson-Crick Model of DNA:

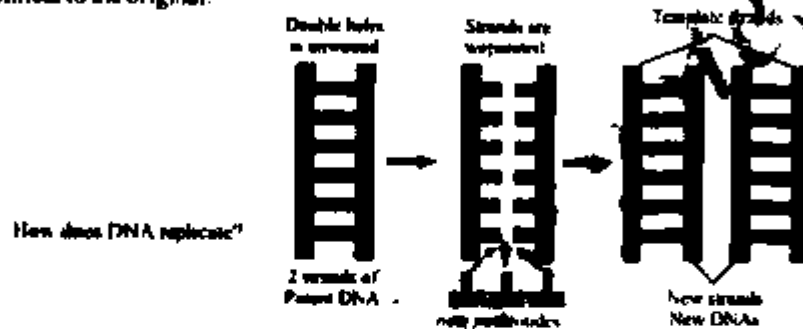
In 1953, James Watson and Francis Crick proposed the structure for DNA.

1. According to the Watson-Crick model, a DNA molecule consists of two polynucleotide strands.
2. These strands are coiled around each other in the form of a double helix. There is a phosphate-sugar backbone on the outside of double helix, and the nitrogenous bases are on the inside. In double helix, the nitrogenous bases of opposite nucleotides form pairs through hydrogen bonds.
3. This pairing is very specific. The nitrogenous base adenine of one nucleotide forms pair with the thymine of opposing nucleotide, while cytosine forms pair with guanine.

4. There are two hydrogen bonds between adenine and thymine while there are three hydrogen bonds between cytosine and guanine

Q.4: What is DNA Replication?

Ans: DNA Replication:

1. It is done to make the copies of the chromatids of chromosomes. During replication, the DNA double helix is unwound and the two strands are separated, much like the two sides of a zipper.
2. Each strand acts as a template to produce another strand. Its N bases make pairs with the N-bases of new nucleotides. In this way, both template strands make new polynucleotide strands in front of them.
3. Each template and its new strand together then form a new DNA double helix, identical to the original.

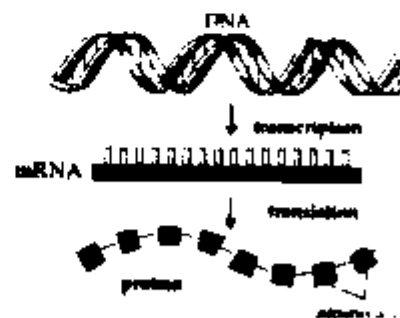
How does DNA replicate?

Q.5: How does the DNA of chromosome work?

Ans: DNA of Chromosome:

DNA is the genetic material i.e. it contains the instructions to direct all the functions of cells. It performs its role by giving instructions for the synthesis of specific proteins. Some proteins perform structural roles while the others act as enzymes to control all biochemical reactions of cells. In this way, whatever a cell does, is actually controlled by its DNA. In other words, DNA makes the characteristic or trait of cell or organism. Let us see how DNA is responsible for this.

We studied that traits are made by specific proteins. Specific proteins have specific number and sequence of their amino acids.

Transcription

DNA controls this sequence of amino acids by the sequence of its nucleotides. During protein synthesis, the sequence of DNA nucleotides decides that what will be the sequence of amino acids. For this purpose, the specific sequence of DNA nucleotides is copied in the form of messenger RNA (mRNA) nucleotides. This process is called transcription.

Translation

The mRNA carries the sequence of its nucleotides to ribosome. The ribosome reads this sequence and joins specific amino acids, according to it, to form protein. This step is known as translation.

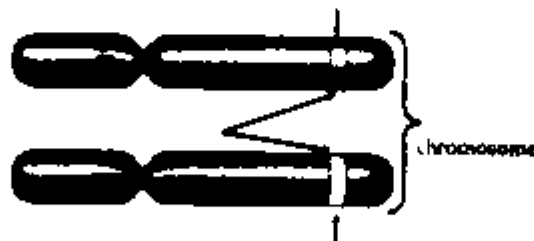
Gene

The part of DNA (sequence of nucleotides) that contains the instructions for the synthesis of a particular protein is known as a gene. DNA of each chromosome contains thousands of genes.

Loci

Like chromosomes, genes also occur in pairs, one on each homologous chromosome. The locations or positions of genes on chromosomes are known as loci *(Singular,* locus).

Example

Each gene determines a particular trait in an organism. Each individual carries at least one pair of genes for each trait. For convenience, pairs of genes are represented by a letter or symbol. Both members of a gene pair may be the same in some individuals (a condition which we may represent as AA or aa or BB) and different in others (Aa or Bb). It means that a gene exists in more than one alternate forms. In the above example, 'A and 'a' are the two alternate forms of a gene and 'B' and 'b' are the alternate forms of another gene. The alternate forms of a gene are called alleles. If an individual has A gene pair, 'A and 'a' are the alleles of one another. In this individual, allele 'A' is located on one of the two homologous chromosomes and the allele'a'.

When chromosomes separate during meiosis, alleles also separate and each gamete gets one of the two alleles. When gametes of both parents unite, the zygote (and the offspring also) receives one allele from each parent.

Q.4: What is Genotype? Give its types.

Ans: Genotype and its Types:

The specific combination of genes in an individual is known as genotype. It is of two types

i.e. homozygous and heterozygous. In order to understand the concept of genotype, let us consider an example trait i.e. albinism (a condition in which normal body pigments are absent). Like other traits, it is also controlled by one pair of genes. We can represent the two alleles of the pair as 'A and 'a' Three combinations i.e. genotypes are possible for these two alleles i.e. AA, Aa, and aa.

Types of Genotype

These genotypes can be grouped into two types.

Homozygous Genotype

The genotype in which the gene pair contains two identical alleles (AA or aa), is called homozygous genotype.

Heterozygous Genotype

The genotype in which the gene pair contains two different alleles (Aa) is called heterozygous genotype.

Dominant Allele

When in the heterozygous condition one allele masks or prevents the expression of the other, it is called the dominant allele.

Recessive Allele

The allele which is not expressed is called recessive. The dominant alleles are represented by capital letters and recessive alleles by lower case letters. Albinism is a recessive trait i.e. it is produced when both alleles are recessive. In humans, allele 'A' produces normal body pigments while allele 'a' does not produce pigments. If genotype is AA or Aa, the individual will produce pigments. On the other hand if genotype is aa, no pigments will be produced and the individual will be albino. In this example, you see that the allele 'A' dominates over 'a', because in Aa individual pigments are produced and the effect of 'a' is suppressed by 'A'. The expression of this genotype in the form of trait (in our example, being albino or having normal pigmentation) is known as the phenotype.

Q.7: Who is Mendel? Why he selected Pea Plants for his experiment?

Ans: Mendel:

Gregor Mendel was a monk (priest) in Austria. He developed the fundamental principles of genetics. Mendel proposed that there are "special factors" in organisms, which control the expression of traits and their transmission to next generations. These factors were eventually termed genes.

Selection of Mendel

Mendel selected pea plant *(Pisum sativum)* to carry out a large number of experiments. In his writings, he gave reasons for this selection. He argued that an organism for genetic experiments should have the following features:

- There should be a number of different traits that can be studied
- The organism should have contrasting traits e.g. for the trait of height there should be only two very different phenotypes i.e. tallness and dwarfness.
- The organism (if it is a plant) should be self-fertilizing but cross fertilization should also be possible.
- The organism should have a short but fast life cycle.
- All these features are present in pea plant. Normally, the flowers of pea plant allow self-pollination.
- Cross pollination can also be done by transferring the pollen grains from the flower on one plant to the flower on another plant. Each trait studied in pea plant had two distinct forms. Mendel's succeeded in his work not only because he selected the right organisms for his experiments but also because he analyzed the results by using the principles of statistics (ratios).

Q.8 What is Mendel's Law of Segregation?

Ans: Mendel's Law of Segregation:

Mendel studied the inheritance of seed shape first. For this purpose, he crossed (reproduced) two plants having one contrasting trait i.e. seed shape.

Monohybrid Cross

Across in which only one trait is studied at a time, is called as a monohybrid cross. Mendel crossed a true breeding round-seeded plant with a true-breeding wrinkled-seeded plant. All resulting seeds of the next generation were round. Mendel declared the trait "round seeds" as dominant, while "wrinkled seeds" as recessive. The following year, Mendel planted these seeds and allowed the new plants to self-fertilize. As a result, he got 7324 seeds: 5474 round and 1850 wrinkled (3 round : 1 wrinkled).

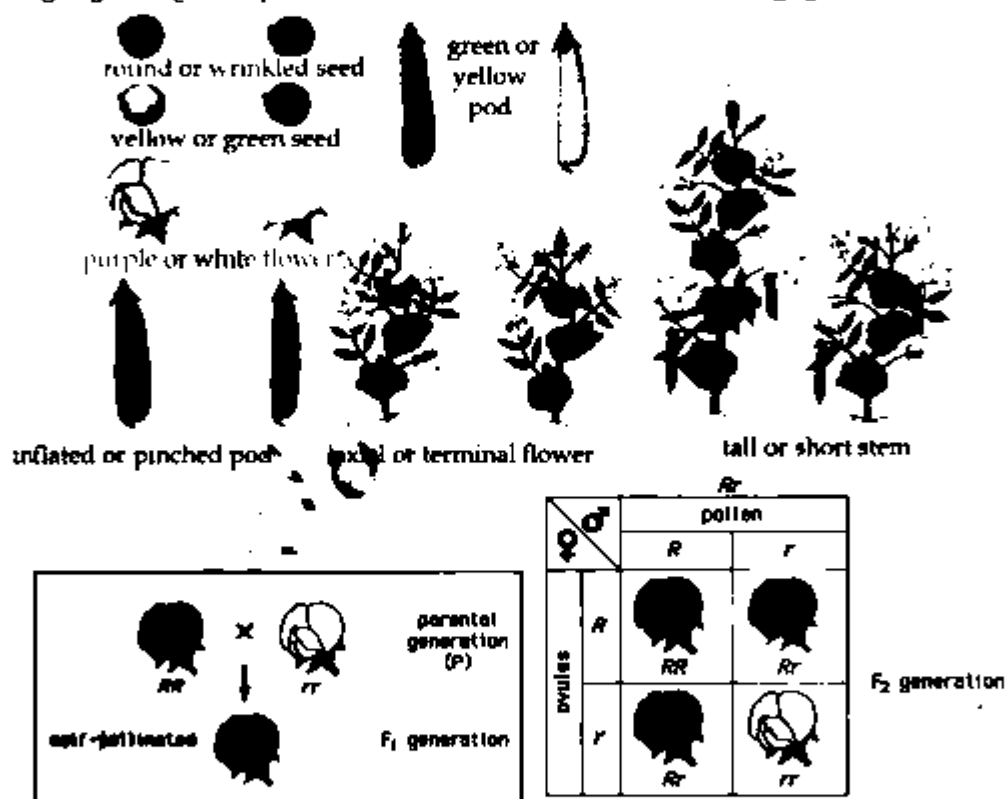
The seven character differences studied by Mendel

Parental Generation:

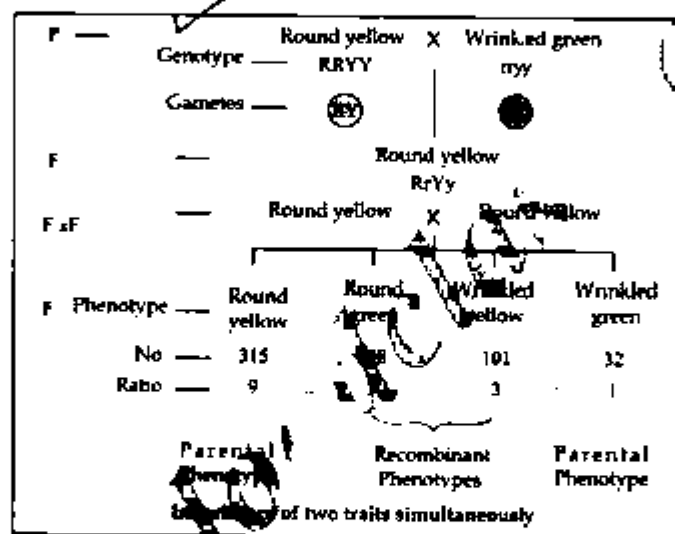
The parental generation is denoted as P1 generation. The offspring of P1 generation are F1 generation (first filial). The cross in F1 generation produces F2 generation (second filial).

Similarly, when "true-breeding" tall plants were crossed with "true-breeding" short plants, all offspring of F1 were tall plants i.e. tallness was a dominant trait. When members of F1 generation were self-fertilized, Mendel got the ratio of tall to short plants in F2 as 3:1.

Mendel's Conclusion

Mendel concluded that the traits under study were controlled by discrete (separable) factors or genes. In each organism, the genes are present in pairs. During gamete formation, the genes (alleles) of each pair segregate from each other and each gamete receives one gene from the pair. When the gametes of male and female parents unite, the resulting offspring again gets the genes in pairs. These conclusions were called the Law of Segregation.

Q.9: What is Mendel's Law of Independent Assorment?
Ans: Mendel's Law of Independent Assortment:

Dihybrid Crosses

Mendel studied two contrasting traits at a time. Such crosses are called dihybrid crosses. He performed experiments on two seed traits i.e. shape and colour. The trait of round seeds (controlled by allele R) was dominant over wrinkled (controlled by allele r) seeds. Similarly yellow seed colour (controlled by Y) was dominant over green (controlled by y). Mendel crossed a true-breeding plant that had round yellow seeds (RRYY) with a true-breeding plant having wrinkled green seeds (rryy). All seeds in F1 generation were round yellow.

Self-fertilization of F1

When F1 seeds grow into plants, they were self-fertilized. This cross produced seeds with four phenotypes. There were 315 round yellow seeds, 108 round green seeds, 101 wrinkled yellow seeds and 32 wrinkled green seeds. The ratio of these phenotypes was 9:3:3:1.

Mendel explained that the two traits i.e. seed shape and seed colour are not tied with each other. The segregation of 'R' and 'r' alleles happens independently of the segregation of Y and 'y' alleles.

From his second experiment, Mendel concluded that different traits are

inherited independently of one another. This principle is known as the law of independent assortment. It states as: "the alleles of a gene pair segregate (get separated and distributed to gametes) independently from the alleles of other gene pairs"..

Punnet square showing genotypic and phenotypic constitution of the F2 generation

(117)

Punnett Square

The Punnett square is a diagram that is used to predict an outcome of a particular cross or breeding experiment. It is named after R. C. Punnett (an English mathematician). The gametes of both parents having all possible genetic set-ups are determined. A checker board is used to cross all the possible gametes of one parent with all the gametes of other parent. In this way, a biologist can find all the possible genotypes of offsprings.

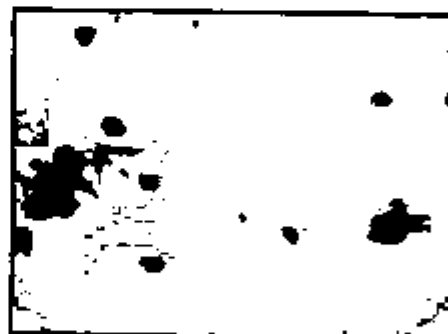
Q.10: What is Co-Dominance and Incomplete Dominance?

Ans: Co-Dominance and Incomplete Dominance

Co-dominance

Co-dominance is the situation where two different alleles of a gene pair express themselves completely, instead of showing a dominant-recessive relationship. As a result, the heterozygous organism shows a phenotype that is different from both homozygous parents.

Example

An example of co-dominance is the expression of human blood group AB. The ABO blood group system is controlled by the gene I. This gene has three alleles i.e. I^A, I^B and i. The allele I^A produces antigen A in blood and the phenotype is blood group A. The allele I^B produces antigen B in blood and the phenotype is blood group B. The allele i does not produce any antigen and the phenotype is blood group O. The alleles I^A and I^B are dominant over i. When there is a heterozygous genotype of $I^A I^B$, each of the two alleles produces the respective antigen and neither of them dominates over the other.

In-complete dominance

In-complete dominance is the situation where, in heterozygous genotypes, alleles express as a blend (mixture) and neither allele is dominant over the other. / of this blending, an intermediate phenotype is expressed. Following is the famili of incomplete dominance.

Example

In Four O clock plant, the trait of flower colour is controlled by two alleles (let us say them R and r). The true breeding plants RR and rr have red and white flowers, respectively. When a homozygous red flowered plant (RR) is crossed with homozygous white flowered plant (rr), the heterozygous (Rr) plants of F1 generation produce pink flowers (pink is a blend of red and white colours). This result clearly indicates that neither of the red flower allele (R) and white flower allele (r) is dominant. However, when two heterozygous plants with pink flowers (Rr) are crossed, F2 generation shows phenotypes of red, pink and white flowers in the ratio 1:2:1.

Four O clock plant

Q.11: What is Variations? Give its types.

Ans: Variations:

Sexual reproduction produces variations in the next generation. No two individuals resulting from separate fertilizations are genetically identical.

Sources of Variation:

(i) The genetic recombination produced through crossing over (recall from previous studies that crossing over occurs during meiosis) results in gametes with variations.

- Mutations (changes in DNA) are important source of variations. Mutations also happen during gametes formation through meiosis.

During fertilization, one of the millions of sperms combines with a single egg. The chance involved in this combination also act as the source of variations.

Gene flow i.e. movement of genes from one population to another is also an important source of variations.

What are Discontinuous and Continuous Variations?

Discontinuous and Continuous Variations:

...ble variations are of two types i.e. discontinuous and continuous variations.

Discontinuous Variations

Discontinuous variations show distinct phenotypes. The phenotypes of such variations cannot be measured. The individuals of a population either have distinct phenotypes, which can be easily distinguished from each other. Blood groups are a good example of such variations.

Example

In a human population, an individual has one of the four distinct phenotypes (blood groups) and cannot have in between. Discontinuous variations are controlled by the alleles of a single gene pair. The environment has little effect on this type of variations.

Continuous Variations

In continuous variations, the phenotypes show a complete range of measurements from one extreme to the other. Height, weight, feet size, intelligence etc. are example of continuous variations.

Example

In every human population, the individuals have a range of heights (from very small to tall). No population can show only two or three distinct heights. Continuous variations are controlled by many genes and are often affected by environmental factors.

Q.13: How Variations lead to Evolution?
Ans: Variations lead to Evolution:

Organic Evolution

Organic evolution (biological evolution) is the change in the characteristics of a population or species of organisms over the course of generations. The evolutionary changes are always inheritable. The changes in an individual are not considered as evolution, because evolution refers to populations and not to individuals.

Processes of Organic Evolution

Organic evolution includes two major processes:

- Alteration in genetic characteristics (traits) of a type of organism overtime.
- Creation of new types of organisms from a single type.

Theory of Special Creation

The study of evolution determines the ancestry and relationships among different kinds of organisms. The anti-evolution ideas support that all living things had been created in their current form only a few thousand years ago. It is known as the "theory of special creation". But the scientific work in eighteenth century led to the idea that living things might change as well.

Work or Charles Darwin

Charles Darwin (1809-1882) proposed the mechanism of organic evolution in 1838. It was called as "The Theory of Natural Selection". Darwin proposed this theory after his 5-year voyage on the HMS (His Majesty's Ship) Beagle. He also published a book "On the Origin of Species by means of Natural Selection" in 1859

Failure of Darwin's Theory of Evolution

Darwin's theory of evolution was not widely accepted because of lack of sufficient evidence. Modern evolutionary theory began in the late 1920s and early 1930s. Scientists proved that the theory of natural selection and Mendelian genetics are the same ideas just as Darwin had proposed

Q. 14: What is Mechanism of Evolution?

Ans: Natural Selection.

Almost every population contains several variations for the characteristics of its members. In other words, there are morphological and physiological variations in all populations. Natural selection is the process by which the better genetic variations become more common in successive generations of a population.

Central Concept

The central concept of natural selection is the evolutionary fitness of an organism. Fitness means an organism's ability to survive and reproduce. Organisms produce more offspring than can survive and these offspring vary in fitness. These conditions produce struggle for survival among the organisms of population. The organisms with favourable variations are able to reproduce and pass these variations to their next generations. On the other hand, the rate of the transmission of unfavourable to next generations is low. We can say that the favourable variations are "selected for" their transmission to next generations, while the unfavourable variations are "selected against" their transmission to next generations

Example

In the example mentioned next, we can see a mouse population with variations in skin colour. Cat preys upon light and medium coloured mouse. In first generation, light coloured mouse is preyed upon by cat. Only medium and dark coloured mouse can make their next generations. In next generation, population again contains light, medium and dark coloured mouse. Cat preys upon the light and medium coloured mouse. Now only the dark coloured mouse make new generation. If this happens in many generations, we will see only the dark coloured (favourable variation) mouse in the population

Conclusion

As a result of natural selection, the allele that gives more fitness of characteristics (favourable variations) than other alleles becomes more common within population. So, the individuals with favourable variations become a major part of population while the individuals with harmful or unfavourable variations become rarer.

Example

In England, the moths had two variations i.e. dark and white coloured moths. The moths used to rest on the light coloured tree trunks (on which white lichens had grown). In the 19th century when industries were established in England, the lichens on tree trunks died (due to polluted air) and the naked tree trunks turned dark. Now the white moth variation became harmful because a white moth resting on a dark tree trunk was easily visible to the predatory birds. The natural selection selected dark moths to reproduce. In this way dark coloured moth became more common and at last the white moths disappeared from population. In this case, the dark colour variation in moth may be considered an adaptation to environment.

Important Information

Different populations face different environments and they have to adapt to different conditions.

Q.15: What is Artificial Selection?

Ans: Artificial Selection:

Background: The term "artificial selection" was expressed by the Persian scientist Abu Rayhan Biruni in the 11th century. Charles Darwin also used this term in his work on natural selection. He noted that many domesticated animals and plants had special properties that were developed by:

(i) Intentional breeding among individuals with desirable characteristics

(ii) Discouraging the breeding of individuals with less desirable characteristics.

Artificial selection (or selective breeding) means intentional breeding between individuals for certain traits, or combination of traits.

Selective Breeding

Selective breeding has revolutionized agricultural and livestock production throughout the world.

Animals or plants having desirable characteristics are selected for breeding. In this way, many new generations with desirable characteristics are produced.

Breeds and Cultivators

In artificial selection, the bred animals are known as breeds, while bred plants are known as varieties or cultivars.

Example

Numerous breeds of sheep, goat, cow, hen etc. have been produced by artificial selection to increase the production of wool, meat, milk, eggs etc.

Similarly many plant varieties (cultivars) have been produced for better quantity and quality of cereals, fruits and vegetables.

CHAPTER # 16
MAN AND HIS ENVIRONMENT

Q1. Define environment?

Ans: Environment:

The sum total of physical (abiotic) and biotic conditions which influence the organism

Every organism has its specific surrounding or environment with which it continuously interacts and remains fully adapted An organism's environment is the sum of physical (abiotic) and biological (biotic) conditions which influence that organism

Q2. Define Ecology.

Ans: Ecology:

The study of the interrelationship between organisms and their environment is called ecology.

Q3. What are the different levels of ecological organization?

Ans: See Q # 1 from Exercise (Short Questions).

A species is a group of organisms which can interbreed freely in nature, to produce fertile offspring

Q4. Define ecosystem and its components.

Ans: See Q # 2 from Exercise (Short Questions).

Q5. Explain how biotic components are further classified?

Ans: Classification of Biotic Components:

i. Producers:

The producers are the autotrophs present in an ecosystem Producers include plants, algae and photosynthetic bacteria. These organisms are able to synthesize complex organic compounds (food) from inorganic raw materials Producers form the basis of any ecosystem

In terrestrial ecosystems, plants are the main producers In aquatic ecosystems, the main producers are the floating photosynthetic organisms (mainly algae) called phytoplankton and shallow water rooted plants.

ii. Consumers:

The consumers are heterotrophs They cannot synthesize their food and so depend upon producers for food. Consumers include all animals, fungi, protozoans and many of the bacteria The animals are the major consumers of ecosystems

Classification of Consumers:

They are further classified as herbivores and carnivores

a. Primary Consumers (Herbivores):

Herbivores e.g. cattle, deer, rabbit, grasshopper etc' feed on plants. They are the primary consumers. They feed directly on plants or products of plants.

b. Secondary Consumers (Carnivores):

Carnivores feed on other animals. Primary carnivores (secondary consumers) feed on herbivores. Fox, frog, predatory birds, many fishes and snakes etc. are primary carnivores.

c. Tertiary Consumers (Secondary carnivores):

Secondary carnivores (tertiary consumers) feed on primary carnivores. Wolf and owl etc. are secondary carnivores. Tertiary carnivores e.g. lion, tiger etc. feed on secondary carnivores.

iii. Decomposers or reducers:

Decomposers or reducers break down the complex organic compounds of dead matter (of plants and animals) into simple compounds. They secrete digestive enzymes into dead and decaying plant and animal remains to digest the organic material. After digestion, decomposers absorb the products for their own use. The remaining substances are added to environment. Many types of bacteria and fungi are the principal decomposers of biosphere.

Q6. Write note on biosphere.

Ans: Biosphere:

The last level of ecological organization, all the ecosystems of the world together form the biosphere.

All ecosystems of the world together form the biosphere. It includes all the ecosystems of the planet Earth. In other words, the biosphere consists of all organisms present on the Earth and all regions of the Earth where they live. Biosphere ranges from the floor of oceans to the tops of the highest mountains. It is about 20 kilometres thick.

Note:

The biosphere makes a thin layer surrounding the planet Earth. If you consider the Earth as of the size of an apple, then the biosphere will be as thick as the apple's skin.

Recalling

Omnivores are the consumers that eat animal flesh as well as plants and plant products.

Examples of omnivores:

Bears, Coatis, Hedgehogs, Opossums, Pigs, Humans, Mice, Rats and Squirrels. Various birds (whose prey can consist of berries and nectar to insects, worms, fish, small rodents and snakes) etc.

Tertiary carnivores/ top carnivores:

Tertiary carnivores are not eaten by any other animals. They are also called top carnivores.

The minerals, which are released by decomposers, are used as nutrients by the producers.

Q7. How the flow of energy is different from that of materials?

Ans: See Q # 3 from Exercise (Short Questions)

Q8. Explain flow of energy in an ecosystem.

Ans: Flow of Energy in Ecosystem:

The flow of energy in different trophic levels of ecosystem is unidirectional The following is an overview of the flow of energy in an ecosystem

Energy flow in an ecosystem

Sun is the primary source of energy:

The Sun is the primary source of energy for all ecosystems Producers get solar energy and transform it into chemical energy by the process of photosynthesis They store this energy in their tissues and also transform it into mechanical and heat energy during their metabolic activities

Flow of energy in producers:

The energy in producers' tissues flows to herbivores when producers are eaten Herbivores transform it into mechanical and heat energy during their metabolic activities and store the rest in their tissues Carnivores eat herbivores and get energy They also use it for their body activities and store the rest in their tissues After the death of producers and consumers, the energy stored in their tissues is used by decomposers.

Law of Thermodynamics:

The storage and expenditure of energy in an ecosystem is in accord... with the basic law of thermodynamics i e 'energy can neither be created nor destroyed but can be transformed from one form into another'

Note: In an ecosystem there is,

i. Constant flow or transfer of energy from the Sun through producers to consumers and decomposers

ii. A significant decrease in useful energy during transfer of energy at each trophic level

Q9. Explain flow of materials in an ecosystem.

Ans: Flow of Materials:

The materials flow from one trophic level to the next by means of food chains and food webs

A food chain is a series of organisms within an ecosystem in which each organism feeds on the one before it and is fed by the one after it. For example following is a food chain in an ecosystem

A simple food chain

The base of food chain is always formed by a plant (producer). It is eaten by a primary consumer which is preyed upon by a secondary consumer. The secondary consumer may be eaten by a tertiary consumer.

A food chain, can therefore be represented as

Producer → Primary Consumer → Secondary Consumer → Tertiary Consumer

A food chain involves a nutritive interaction among the biotic components of an ecosystem. Usually there are 4 or 5 trophic levels. Shorter food chains provide greater available energy and vice -versa.

Food web:

In nature, food chains are very complex as one organism may be the food source of many other organisms. Thus, instead of a simple linear food chain, there is a web-like structure formed by these interlinked food chains. Such interconnected food chains collectively make "food web". Food web can be defined as, "a network of food chains which are interconnected at various trophic levels.

A food web in grassland ecosystem

Q10. How would you describe the ecological pyramids?

Ans: Ecological pyramids:

In 1927, Charles Elton (an English ecologist) developed the concept of ecological pyramids. He noted that the animals present at the beginning of food chain are abundant in number while the animals present at the end of food chain are fewer in number. Ecological pyramid can be defined as, "A representation of the number of individuals or amount of biomass or energy present in various trophic levels of a food chain"

Types of Ecological pyramids:

Ecological pyramids are of three types

i. Pyramid of Numbers ii. Pyramid of Biomass
iii. The Pyramid of Energy

Q11. Explain what do you mean by the pyramids of number and biomass.

Ans: See Q # 1 from Exercise (Understanding the Concept).

Q12. Define "Biomass"?

Ans: The total amount of living or organic matter in an ecosystem at any time is called "biomass"

Q13. How would you describe biogeochemical cycles?

Ans: Biogeochemical Cycles:

Biogeochemical cycles are the cyclic pathways through which materials move from environment to organisms and back to environment

Environment is the source of materials for all living organisms. Environment provides bioelements which are used by organisms for their bodies and metabolism. The materials are continuously recycled between organisms and environment

Carbon cycle:

The biogeochemical cycle in which carbon flows between organisms and the environment

Nitrogen cycle:

The flow of nitrogen between environment and the organisms

Nutrient Cycles:

Since such movement of elements and inorganic compounds is essential for maintenance of life, they are also called 'nutrient cycles'

Q14. Write a note on Carbon cycle.

Ans: See Q # 2 from Exercise (Understanding the Concept)

Q15. Explain how human activities have contributed to the k... of balance in nature.

Ans: See Q # 5 from Exercise (Understanding the Concept)

Q16. Define nitrogen cycle.

Ans: Nitrogen cycle:

The flow of nitrogen between environment and the organisms is called nitrogen cycle.

Nitrogen is an important component of many biomolecules, like proteins and nucleic acids (DNA and RNA). Atmosphere is the reservoir of free gaseous nitrogen. Living organisms cannot pickup this gaseous nitrogen directly from atmosphere (except for nitrogen fixing bacteria). It has to be converted into nitrates to be utilised by plants

Q17. What are the different stages of Nitrogen cycle?

Ans: See Q # 3 from Exercise (Understanding the Concept)

Q18. Differentiate between Intraspecific and Interspecific interactions in ecosystem.

Ans: Intraspecific Interactions in ecosystem.

The interactions between the members of the same species are called intraspecific interactions.

Interspecific interactions in ecosystem:

The interactions between the members of different species are called interspecific interactions Some important interactions among living organisms in ecosystems are given below.

i. Competiton . ii. Predation ii. Symbiosis

Q19. Write notes on competition, predation and symbiosis.

Ans: See Q # 4 from Exercise (Understanding the Concept)

Q20. Describe the symbiosis between honeyguide bird and badger?

Ans: The honeyguide bird feeds on wax and the larvae present in honeycombs It flies around looking for honeycombs, but it is not strong enough to open the comb Badgers are large mammals that feed on honey. When a honeyguide bird goes to find honeycombs, the badger follows it. When the bird finds a honeycomb, it calls the badger.

Sometimes the bird has to stop and wait for the slow-moving badger After reaching there, the badger opens the honeycomb and both of them eat their foods together Traditionally, humans have also used these birds to find honeybee colonies

Q21. Write a note on Global Warming.

Ans: Global Warming:

Increase in the temperature of the Earth; due to the addition of greenhouse gases in atmosphere, which do not allow solar radiations to reflect back into the space.

The addition of greenhouse gases (e.g. carbon dioxide, methane, ozone) in atmosphere increases the temperature of the Earth These gases remain in the lowest part of Earth's atmosphere and do not allow solar radiations to reflect back into space. As a result, heat remains within the Earth's atmosphere and increases its temperature. This is called global warming

Effects of Global Warming:

Due to global warming, polar ice-caps and glaciers are melting faster than the time taken for new ice layers to form. Sea water is also expanding causing sea levels to rise Due to melting glaciers, rivers overflow and cause floods

In 1990 United Nation established intergovernmental Panel on Climate Change (IPCC).It provides scientific advice to the world leaders on issues like the build-up of greenhouse gases and its prevention

According to IPCC, Earth's surf. temperature has increased ≈ 0 2°C per decade in the past 30 years

The Maldives' Survival

Scientists fear that the sea level is rising up to 0.9cm a year Rise in sea level has worst effects on coastal countries Most of the islands of the Maldives are less than 1 metre above sea level It is estimated that within 100 years, the Maldives might become uninhabitable and the citizens would be forced to evacuate

Q22. Write a note on Greenhouse Effect.

Ans: Greenhouse Effect:

The term 'Greenhouse Effect' refers to the phenomenon in which certain gases (called greenhouse gases) trap heat in the atmosphere These gases act like the glass in a greenhouse which does not allow the inner heat to escape When sunlight reaches the surface of the Earth much of its energy is transformed into heat energy The Earth surface reflects this heat energy towards space as infrared radiation

The greenhouse gases trap infrared radiation and send it back to Earth Carbon dioxide methane and nitrous oxide are important greenhouse gases Since 1800, the amount of Carbon dioxide in atmosphere has increased 30 % The amount of methane has more than doubled and the amount of nitrous oxide has increased about 8%

Q23. Write a note on Acid Rains. Highlight Some of the significant ill effects of acid rain.

Ans: Acid Rains:

When rain falls through polluted air, it comes across chemicals such as oxides of sulphur and nitrogen These chemicals interact with water vapours in the presence of sunlight to form sulphuric acid and nitric acid These acids remain as vapour at high temperatures

As temperature falls, the acids begin to condense into liquid form and mix with rain or snow, on the way down to the Earth This makes rain acidic with pH range of 3 to 6 .

Some of the significant ill effects of acid rain are:

i. Acid rain destroys the necessary nutrients present in the waters of rivers and lakes etc Its also lowers the pH of water Most of the aquatic animals cannot survive at this pH
ii. Acid rain washes nutrients out of soil, damages the bark and leaves of trees and harms root hairs Leaf pigments (chlorophyll) are also destroyed
iii. Metalic surfaces exposed to acid rain are easily corroded Fabrics paper and leather products lose their material strength or disintegrate easily
iv. Building materials such as limestone, marble dolomite, mortar and slate are weakened with acid rains because of the formation of soluble compounds

Thus acid rain is dangerous for historical monuments The building of famous Taj Mahal has been corroded at many places due to acid rains

Taj Mahal and its corroded door

Q24. Write a note on Deforestation.

Ans: Deforestation:

Deforestation means clearing of forests by natural causes or humans. Large areas of forests have been cleaned for agriculture, factories, roads, rail tracks and mining. Humans cut trees for getting wood (lumber), which is then used for making structures and for heat production. Human preys upon forest animals, which are the predators of many insect pests. In this way, insect pests destroy forests by eating the shoots and spreading diseases.

Effects of deforestation:

The effects of deforestation include floods, droughts, landslides and soil erosions, global warming and loss of habitat of many species.

Q25. Write a note on Overpopulation.

Ans: Overpopulation:

When the industrial revolution started some 250 years ago, the world population was at 600 million - that seems like a lot of people but now the world population is almost ten times at 6 billion and will grow to 8 billion by 2025. Better health facilities and lowered mortality rates have contributed in population growth.

Year	Population	Year	Population
1981	85,096,000	1999	134,790,000
1984	92,284,301	2002	144,902,409
1987	99,953,232	2005	155,772,000
1990	107,975,060	2008	166,111,487
1993	116,444,165	2009	169,708,303
1996	125,409,651	2010	173,510,000

THE POPULATION OF PAKISTAN **Source:** The World Bank

Q26. Write a note on Urbanization.

Ans: Urbanization:

Urbanization means growing of cities. People move from rural areas to cities in search of better jobs, education opportunities and higher standards of living. If there is rapid urban growth, the governments find it difficult to provide even the basic facilities like health, education, shelter, water, electricity etc. Most of the migrants in cities do not find good jobs and become the part of urban poor. There is overcrowding in schools, hospitals etc.

The slum areas increase in number and people living there are at great risk of diseases. Urbanization is a global problem and cannot be stopped but it can be managed. The current level of urbanization in Pakistan is about 32% which is not high global standards.

Planned urbanization:

A planned urbanization can solve many problems. The cities should have thick green belts in their surroundings to control pollution. The open spaces in cities should be reserved through zoning and land plans. The urban spread-out should also be controlled.

PAKISTAN: URBAN POPULATION (%age)
Source: The World Bank

Utilization of public transport instead of individual transports also proves effective way to manage urbanization.

Q27. Define pollution.

Ans: Pollution:

Pollution is defined as any undesirable change in the physical, chemical or biological characteristics of air, water and land that may harmfully affect living organisms and natural resources.

Q28. Define pollutants.

Ans: Pollutants:

The substances that actually cause pollution are called the pollutants. They may be the industrial effluents, domestic wastes, medical wastes etc. Pollutants are of two types i.e. biodegradable and non-biodegradable.

Q29. Write note on the causes and effects of the air and water pollutions.

Ans: See Q # 6 from Exercise (Understanding the Concept).

Q30. Write a note on causes and control of Land Pollution.

Ans: Land Pollution:

Land (soil) is an important resource as it is the basis for the growth of producers. In the recent times, soil has been subjected to pollution.

Causes of Land Pollution:

The pesticides used in agriculture have chemicals that stay in soil for long times. The acid rains change the pH of soil making it unsuitable for cultivation. The household and other city garbage lies scattered in soil in the absence of a proper disposal system. Materials like polythene block the passage of water into soil and so decrease the water-holding capacity of soil.

Many industries produce harmful chemicals which are disposed of without being treated. Improper disposal of nuclear wastes also causes radioactive substances to remain in soil for a long time. Open latrines in villages and some parts of cities are also the source of land pollution.

Control of Land Pollution:

There should be suitable and safe disposal of wastes including nuclear wastes.

Non-biodegradable materials like plastic, glass, metals etc. should be recovered and recycled. Inorganic pesticides should be replaced by organic pesticides.

Q31. What do you mean by conservation of nature?

Ans: Conservation of Nature:

Conservation of nature means the conservation of natural resources. Everything that we use or consume e.g. food, petrol etc. is obtained from natural resources. The renewable natural resources e.g. air are reproduced easily but the non-renewable resources (e.g. minerals and fossil fuels) are not replenished once they get depleted. We have to conserve the non-renewable resources because their reserves are limited and humans are heavily dependent on them for daily needs. The renewable resources too have to be judiciously used. To ensure sustainable use of resources in our environment, we should act upon the principle of The 3R' i.e. Reduce, Reuse, and Recycle.

Interesting Information

Unwanted, unpleasant and annoying ids are termed as noise. Noise is considered as a form of pollution. Immediate effects of noise pollution are annoyance and aggression and the long term effects are hearing loss, depression hypertension etc.

Interesting Information

According to estimates, at the current of increase, the average global temperature will go up by 3°C to 8°C in the next 100 years.

Interesting Information

There are more than 200 tanneries (industry where raw skin is treated to make leather) operating in Kasur city The industry discharges 9000 cubic metres of waste water daily into the nearby water bodies This water contains heavy metals and becomes a part of the underground water In 2003 a survey showed that two-thirds of residents and 72 percent of tannery workers suffered cancer infections of the kidney or loss of eyesight Tests showed that the drinking water was contaminated with lead mercury and chromium

Interesting Information

The Pakistan government and the United Nations Development Programme (UNDP) launched the Kasur Tannery Pollution Control Project The project has established an effluent treatment plant, chromium plant and a solid waste disposal site

Q32. What do you mean by the concept of 3Rs with reference to the conservation of natural resources?

Ans: See Q # 5 from Exercise (Short Questions)

Q33. Highlight the different Plans for the Conservation of Nature in Pakistan.

Ans: Plans for the Conservation of Nature:

i. In 1992 Pakistan developed and the National Conservation Strategy The main objectives of the strategy are conservation of natural resources and improved efficiency in the use of resources It also covers the policies for promoting efficiency and conservation of energy resources

The Federal Ministry of Environment has launched the National Drinking Water and Sanitation Policy It focuses on the provision of clean drinking water to entire population and the conservation of water resources

Water purification plants are being installed all over the country

ii. In 2006 the UNDP launched the project "Mass Awareness for Water Conservation and Management" The objective of the project was to launch a comprehensive awareness campaign for the conservation and management of water resources in Pakistan

iii. The organization SCOPE (Society for Conservation and Protection of Environment) works with government for mass awareness and research for the conservation of natural resources in Pakistan

iv. The WWF (old name is World Wildlife Fund but now it is called World Wide Fund for Nature) is working on many projects related to the conservation of nature

Q34. What are the different programmes of WWF-Pakistan.

Ans: Programmes of WWF-Pakistan:

The following are some important programmes of WWF-Pakistan (in collaboration with the government of Pakistan)

i. Improving sub-watershed management and environmental awareness around Ayubia National Park

ii. Plantation of the trees of Jatropha and Mangroves at District Thatta Sindh

iii. District-wise forest cover assessment of Pakistan
iv. Saving Wetlands Sky High Programme (for the conservation and management of high altitude wetlands)
v. Indus Basin Water Security Project (to protect the water-flow needed for the maintenance of river ecosystem and for the benefit of nearby areas)
vi. Regional Climate Risk Reduction in Himalayas

Interesting Information

Clean water, air, fuels, agricultural land and forests appeared to be plentiful earlier but now these are becoming scarce. If we continue depleting them like this we will be creating untold misery for ourselves and for our future generations.

Interesting Information

A recycling of one tonne of paper can save 17 trees

Interesting Information

We can add the R4 i.e. Reforest. Trees should be planted during the rains. Trees make our environment more cool, shady and green.

Q35. Briefly describe the basic information about dengue fever.

Ans: Basic information about dengue fever:

Dengue fever is a viral infection transmitted through a mosquito *Aedes aegypti*. It has become a major health problem in tropical and sub-tropical countries, including Pakistan. There are four types of dengue virus. Recovery from infection by one provides lifelong immunity against that virus but provides no protection against infection by the other three viruses. According to the World Health Organization there are 50 million dengue infections worldwide every year. Now, there are 2.5 billion people at risk from dengue.

The female *Aedes* mosquito gets the virus when it bites an infected person. When an infected mosquito bites another person, viruses enter his / her blood and attack white blood cells. Inside WBCs, viruses reproduce and destroy them. In severe cases, the virus affects liver and bone marrow. As a result there is a decrease in the production of blood platelets and patient suffers from bleeding. Other symptoms of dengue include high fever, severe headache, pain behind the eyes, muscle and joint pains and rash.

Sometimes, dengue fever converts into dengue haemorrhagic fever (DHF) or into dengue shock syndrome (DSS). DHF results in bleeding, low levels of blood platelets and blood plasma leakage. In DSS the blood pressure falls dangerously low.

There is no vaccine or treatment for dengue fever. At present, the only method of controlling dengue virus transmission is to check the spread of Aedes mosquitoes.

Aedes aegypti breeds primarily in the containers used for water storage, discarded plastic containers, used automobile tyres and other items that collect rainwater. The mosquitoes can be controlled through proper solid waste disposal and improved water storage practices. Small fish and crustaceans have also been used for killing the larvae of the mosquito. Insecticide sprays have not proved efficient in killing the mosquitoes, because spray does not penetrate all habitats of adult mosquitoes.

MULTIPLE CHOICE

1. Which of the following is the abiotic component of the ecosystem?
A. Producers — B. Herbivores
C. Carnivores — D. Oxygen

2. When we eat onions, our trophic level is;
A. Primary consumer — B. Secondary consumer
C. Decomposer — D. Producer

3. Identify the correctly matched pair:
A. Rainfall - biotic factors in ecosystem
B. Global warming - formation of fossil fuels
C. Renewable natural resource - air
D. Corn - secondary consumer

4. In the food chain tree → caterpillar → robin → hawk → coyote, which is the secondary consumer?
A. Caterpillar — B. Robin
C. Hawk — D. Coyote

5. In ecosystems, the flow of______ is one way, while______ is/are constantly recycled
A. Minerals, energy — B. Energy, minerals
C. Oxygen, energy — D. Glucose, water

6. In the food chain "grass → rabbit→fox →bear→mushroom", how many types of decomposers are present?
A. 1 — B. 2 — C. 3 — D. 4

7. Organisms in the ecosystem that are responsible for the recycling of plant and animal wastes are:
A. Producers — B. Consumers
C. Decomposers — D. Competitors

8. Which form of Nitrogen is taken by the producers of the ecosystem?

A Nitrogen gas B Ammonia
C Nitrites D Nitrates

Answers

1. D	2. A	3. C	4. B	5. B
6. A	7. C	8. D		

1. What are the different levels of ecological organization?

Ans: Levels of Ecological Organization:

In ecology, the levels of organization range from organism to biosphere. An organism may be unicellular or multicellular

Population:

A group of the organisms of the same species inhabiting a specific geographical area (habitat) at a particular time is called a population.

Community:

All the populations that live in a habitat and interact in various ways with one another are collectively called a community.

2. Define ecosystem and its components.

Ans: The self-sufficient unit of an environment that is formed as a result of interactions between its biotic community and the abiotic components is known as an **ecosystem.**

Components of Ecosystem:

Ecosystem comprises of two basic parts i.e.

i. Abiotic Components
ii. Biotic Components

Abiotic components:

The **abiotic components** include the non-living factors present in ecosystem. The important non-living factors are light, air, water, soil and the basic elements and compounds.

Biotic Components:

The **biotic components** comprise the living part (organisms) of the ecosystem. Biotic components are further classified as producers, consumers and decomposers

3. How the flow of energy is different from that of materials?

Ans: Flow of Energy in Ecosystem:

The flow of energy in different trophic levels of ecosystem is unidirectional. The following is an overview of the flow of energy in an ecosystem

Energy flow in an ecosystem

Sun is the primary source of energy:

The Sun is the primary source of energy for all ecosystems. Producers get solar energy and transform it into chemical energy by the process of photosynthesis. They store this energy in their tissues and also transform it into mechanical and heat energy during their metabolic activities.

Flow of energy in producers:

The energy in producers' tissues flows to herbivores when producers are eaten. Herbivores transform it into mechanical and heat energy during their metabolic activities and store the rest in their tissues. Carnivores eat herbivores and get energy. They also use it for their body activities and store the rest in their tissues. After the death of producers and consumers, the energy stored in their tissues is used by decomposers.

Law of Thermodynamics:

The storage and expenditure of energy in an ecosystem is in accordance with the basic law of thermodynamics i.e. 'energy can neither be created nor destroyed but can be transformed from one form into another'.

Note:

In an ecosystem there is,

i. Constant flow or transfer of energy from the Sun through producers to consumers and decomposers.
ii. A significant decrease in useful energy during transfer of energy at each trophic level.

Flow of Materials:

The materials flow from one trophic level to the next by means of food chains and food webs. A food chain is a series of organisms within an ecosystem, in which each organism feeds on the one before it and is fed by the one after it. For example, following is a food chain in an ecosystem.

A simple food chain

The base of food chain is always formed by a plant (producer). It is eaten by a primary consumer, which is preyed upon by a secondary consumer. The secondary consumer may be eaten by a tertiary consumer.

A food chain, can therefore, be represented as:

Producer → Primary Consumer → Secondary Consumer → Tertiary Consumer

A food chain involves a nutritive interaction among the biotic components of an ecosystem. Usually there are 4 or 5 trophic levels. Shorter food chains provide greater available energy and vice -versa.

Food web:

In nature, food chains are very complex, as one organism may be the food source of many other organisms. Thus, instead of a simple linear food chain, there is a web-like structure formed by these interlinked food chains. Such interconnected food chains collectively make 'food web'. Food web can be defined as, "a network of food chains which are interconnected at various trophic levels.

A food web in grassland ecosystem

4. Define food chain and food web.

Ans: Food chain:

The series of organisms in an ecosystem, in which an organism eats the preceding one and is eaten by the next one is called food chain.

Food web:

A network of interconnected food chains, has a number of feeding connections amongst different organisms of a community is called food web

OR (Second Answer)

Food Chain:

A simple chain of feeding relationship between three or four organisms is called a food chain

Food Web:

A food web is a diagram, of some sort, that links at least two food chains together. Food webs describe how energy is passed throughout a section of an ecosystem (or an entire ecosystem)

5. What do you mean by the concept of 3Rs with reference to the conservation of natural resources?

Ans: To ensure sustainable use of resources in our environment, we should act upon the principle of The 3R' i.e. Reduce, Reuse, and Recycle

The R1: Reduce:

We should use the natural resources less and should not waste them. We should use this principle at different places, in our daily lives. We should not waste water, electricity, fuel etc

We should turn off the tap when not in use. We should bathe with a bucket instead of shower. The lights and fans should be off, when we are not in room. We should take public transport (like buses) or walk short distances instead of using motor fuel. We should not waste food and should give unused food to poor people

The R2: Reuse:

We should use things again and again. We should not throw away materials such as glass containers, plastic bags, paper, cloth etc. These should be reused at domestic levels rather than being thrown. It also reduces solid waste pollution.

The R3: Recycle:

Materials such as paper, plastic, glass etc. can be recycled. This decreases the volume of refuse and helps in the conservation of natural resources

UNDERSTANDING THE CONCEPT

1. Explain what do you mean by the pyramids of number and biomass.

Ans: i. Pyramid of Numbers:

It is the graphic representation of the number of individuals per unit area at various trophic levels. Usually, producers are present in large number, primary consumers are in lesser number, secondary consumers are fewer, and so on. So, the producers are of smallest size but maximum in number while the tertiary consumers are larger in size but lesser in number

ii. Pyramid of Biomass:

It is the graphic representation of biomass present per unit area at different trophic levels. In a terrestrial ecosystem, the maximum biomass occurs in producers, and there is progressive decrease in biomass from lower to higher trophic levels

Pyramid of numbers in an ecosystem

Pyramid of biomass in an ecosystem

2. Write a note on Carbon cycle.

Ans: Carbon cycle:

The biogeochemical cycle in which carbon flows between organisms and the environment is called carbon cycle

Carbon atom is the principal building block of many kinds of biomolecules Carbon is found as graphite and diamond in nature It also occurs as carbon dioxide in atmosphere

Major source of carbon:

Major source of carbon for the living world is carbon dioxide present in atmosphere and water Fossil fuels like peat. coal, natural gas and petroleum also contain carbon Carbonates of Earth's crust also give rise to carbon dioxide

Photosynthesis and Carbon:

The major process that brings carbon from atmosphere or water into living world is photosynthesis Producers take in carbon dioxide from atmosphere and convert it into organic compounds In this way carbon becomes a part of the body of producers This carbon enters food chains and is passed to herbivores carnivores and decomposers

Respiration:

Carbon dioxide is released back to environment by respiration of producers and consumers It is also released by the decomposition of organic wastes and dead bodies by decomposers

Combustion:

Burning of wood and fossil fuels also adds large amount of carbon dioxide into atmosphere

Green house effect and global warming:

Human activities have contributed to the loss of balance in nature because the balance of carbon cycle has been upset by human activities such as deforestation and excessive burning of fossil fuels As a result, the amount of carbon dioxide in atmosphere is increasing causing the green house effect and global warming

Note: Carbon cycle is a perfect cycle in the sense that carbon is returned to atmosphere as soon as it is removed

3. What are the different stages of Nitrogen cycle?

Ans: Stages of Nitrogen cycle:

Nitrogen cycling involves several stages

a. Formation of Nitrates:

It is done by the following ways

I. Nitrogen Fixation:

Conversion of nitrogen gas into nitrates is called nitrogen fixation It occurs in the following ways

a. Atmospheric nitrogen fixation:

Thunderstorms and lightning convert atmospheric gaseous nitrogen to oxides of nitrogen These oxides dissolve in water and form nitrous acid and nitric acid The acids in turn combine with other salts to produce nitrates It is called as atmospheric nitrogen fixation

b. Biological nitrogen fixation:

Some bacteria also have the ability to transform gaseous nitrogen into nitrates. It is called biological nitrogen fixation. Some of these nitrogen fixing bacteria live as symbionts and many are free-living.

c. Industrial nitrogen fixation:

Nitrogen fixation is also done in industries. In industrial nitrogen fixation, hydrogen is combined with atmospheric nitrogen under high pressure and temperature. It produces ammonia which is further converted into ammonium nitrate.

Nitrogen cycle

ii. Ammonification and Nitrification:

Ammonification is the breakdown of the proteins of dead organisms and nitrogenous wastes (urea, uric acid etc.) to ammonia. It is done by ammonifying bacteria. After the formation of ammonia, it is converted into nitrites and nitrates. It is called nitrification and is done by nitrifying bacteria. First, ammonia is converted into nitrites by bacteria (e.g. Nitrosomonas). The nitrites are then converted into nitrates by other bacteria (e.g. Nitrobacter).

b. Assimilation:

The nitrates formed by the above processes, are absorbed by plants and are utilized for making proteins etc. Animals take nitrogenous compounds from plants. The utilization of nitrates by organisms is called assimilation.

c. Denitrification:

It is a biological process in which nitrates and nitrites are reduced to nitrogen gas by denitrifying bacteria. By this process, nitrogen is returned to atmosphere.

Note:

Excessive denitrification reduces soil fertility and is stimulated by water logging, lack of aeration and accumulation of organic matter in the soil.

4. Write notes on competition, predation and symbiosis.

Ans: i. Competition:

In ecosystems, the natural resources e.g. nutrients, space etc. are usually in short supply. So there is a competition among the organisms of ecosystem for the utilization of resources. The competition may be intraspecific or interspecific.

Intraspecific competition is always stronger and more severe than the interspecific competition. Competition helps in maintaining a balance between the available resources and the number of individuals of a species.

Plants also show competition for space, light, water and minerals.

ii. Predation:

It is an interaction between two animals of different species or between a plant and an animal. In predation, one organism (the predator) attacks, kills and feeds on other organism (the prey).

Some examples of predation are given below.

I. All carnivore animals are predators. For example, frog preys upon mosquito and fox preys upon rabbit. There are some examples where a predator is preyed upon by a second predator and then the second one is preyed upon by a third predator. For example, frog (predator 1) is preyed upon by a snake (predator 2) and the snake is preyed upon by an eagle (predator 3).

II. Certain plants (Pitcher plant, sundew, Venus fly trap etc.) are carnivorous and live as predators. Such plants live in the areas where minerals and other nutrients are lacking. They feed on insects to fulfill their nitrogen requirements. These plants have mechanism to attract insects. For example, they secrete sweet nectar that attracts the insects searching for food. Their leaves are also modified to capture the prey.

Predator Plants

Note:

Predation keeps the prey population under check, so as to maintain an ecological balance. Humans benefit from this interaction in the biological control of weeds and pests. In order to control pests in an area, their predators are released there

iii. Symbiosis:

It is a relationship between members of different species, in which they live together for longer or shorter periods of time

Types of Symbiosis:

Symbiosis is of three types.

a. Parasitism:

It is a type of symbiosis (between members of different Species) in which smaller partner (parasite) derives food and shelter from the body of larger partner (host) and, in turn, harms it.

Temporary Parasitism:

In temporary parasitism, the parasite spends most of its life cycle as independent free-living organisms. Only a part of its life cycle is spent as a parasite Leech, bed bug, mosquito are common temporary parasites of humans

Permanent Parasitism:

In permanent parasitism, the parasites spend their whole life cycle as parasites. Many disease causing bacteria and all viruses are permanent parasites.

Classificatiion of Parasites:

Parasites may also be classified as ectoparasites and endoparasites.

Ectoparasites:

Ectoparasites live outside i.e. on the surface of host's body and get food from there. Mosquitoes, leeches, lice etc are the examples of ectoparasites

Endoparasites:

Endoparasites live inside the body of host and get food and shelter Bacteria, viruses, tapeworm, Ascaris, Entamoeba, Plasmodium etc. are the examples of endoparasites

Some endoparasites

Parasitic plants:

Some plants (e.g. Cuscuta, also called dodder) are parasites on other plants Parasitic plants grow special types of roots (haustoria) into host body and suck the required nutrients from the vascular tissues of host

Note: Host can survive without parasite but parasite cannot survive without host

b. Mutualism:

In this type of symbiotic interaction, both partners (of different species) get benefit and neither is harmed

For example:

Termites eat wood but are not able to digest it. A protozoan lives in its intestine. It secretes 'cellulase' enzyme to digest the cellulose of wood. In return, the termite provides food and shelter to the protozoan.

Rhizobium:

The nitrogen fixer bacteria *Rhizobium* live in the root nodules of leguminous plants like pea, gram etc. The bacteria obtain food and shelter from plants while in return they fix gaseous nitrogen into nitrates for the plant which is required for their growth

Figure 16.14: Termite, with a protozoan in its gut

Figure 16.15. Bacteria in root nodules

Termite, with a protozoan in its gut

c. Commensalism:

It is a type of symbiosis in which one partner is benefited while the other is neither benefited nor harmed. For example

Epiphytes:

Epiphytes are small plants found growing on other larger plants for space only. They absorb water and minerals from atmosphere and prepare their own food. The larger plants are neither benefited nor harmed in any way.

Sucker fish:

Sucker fish attaches to the surface of sharks by its sucker. In this way, the shark provides easy transport to the sucker fish to new feeding grounds

(a) (b)

a An epiphyte orchid plant growing on a tree trunk

b A sucker fish attached with shark

5. Explain how human activities have contributed to the loss of balance in nature.

Ans: Loss of balance in nature:

Human activities contribute to climate change by causing changes in Earth s atmosphere in the amounts of greenhouse gases, aerosols (small particles), and cloudiness

The largest known contribution comes from the burning of fossil fuels, which releases carbon dioxide gas to the atmosphere Greenhouse gases and aerosols affect climate by altering incoming solar radiation and out- going infrared (thermal) radiation that are part of Earth's energy balance Changing the atmospheric abundance or properties of these gases and particles can lead to a warming or cooling of the climate system

Greenhouse Gases:

Human activities result in emissions of four principal greenhouse gases carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and the halocarbons (a group of gases containing fluorine, chlorine and bromine) These gases accumulate in the atmosphere causing concentrations to increase with time Significant increases in all of these gases have occurred in the industrial era All of these increases are attributable to human activities.

Carbon dioxide has increased from fossil fuel use in transportation, building heating and cooling and the manufacture of cement and other goods Deforestation releases CO_2 and reduces its uptake by plants Carbon dioxide is also released in natural processes such as the decay of plant matter

Methane has increased as a result of human activities related to agriculture, natural gas distribution and landfills Methane is also released from natural processes that occur, for example, in wetlands. Methane concentrations are not currently increasing in the atmosphere because growth rates decreased over the last two decades

Nitrous oxide is also emitted by human activities such as fertilizer use and fossil fuel burning Natural processes in soils and the oceans also release N_2O

The abundance of chlorofluorocarbon gases is decreasing as a result of international regulations designed to protect the ozone layer

Ozone is a greenhouse gas that is continually produced and destroyed in the atmosphere by chemical reactions In the troposphere, human activities have increased ozone through the release of gases such as carbon monoxide hydrocarbons and nitrogen oxide which chemically react to produce ozone As mentioned above halocarbons released by human activities destroy ozone in the stratosphere and have caused the ozone hole over Antarctica

6. Write note on the causes and effects of the air and water pollutions.

Ans: 1. Air Pollution:

Air pollution is one of the major environmental issues of today It is defined as the change of composition of air by the addition of harmful substances (e g industrial and automobile gases and particulate matter)

Sources of Air Pollution:

All sources of air pollution. are related to human activities Burning of coal produces a lot of smoke and dust whereas burning of petroleum produces sulphur dioxide

In addition to these air pollutants include carbon monoxide, carbon dioxide, nitrogen oxides, hydrocarbons, particulate matter and traces of metals Different industries produce air pollution in the following way

Fertilizer industries release oxides of sulphur and nitrogen, hydrocarbons, particulate matter and fluorine.

Thermal industries are coal based and their pollutants are fly ash, soot and sulphur dioxide

Textile industries release cotton dust, nitrogen oxides, chlorine, smoke and sulphur dioxide

Steel industries release carbon monoxide, carbon dioxide, sulphur dioxide, phenol, fluorine, cyanide. particulate matter etc

Effects of Air Pollution:

i. Smog formation:

When pollutants like hydrocarbons and nitrogen oxides combine in the presence of sunlight, smog is formed. This is a mixture of gases. It forms a yellowish brown haze especially during winter and hampers visibility It also causes many respiratory disorders and allergies as it contains polluting gases

ii. Acid rains:

The air pollutants like sulphur dioxide and nitrogen oxides react with water in the atmosphere producing acid rains

iii. Ozone depletion:

The upper layer (stratosphere) of the atmosphere has ozone (O_3) which absorbs ultraviolet (UV) rays present in the sun's radiation However, the air pollutants like chlorofluorocarbons (CFCs) destroy the ozone molecules and so break the ozone layer Ozone holes are created which permit UV rays to reach the Earth's surface The UV rays increase the temperature and also cause skin cancers

The harmful effects of the UV rays are visible in the countries such as Australia and New Zealand where the rate of skin cancer is higher than the other regions of the world

Control of Air Pollution:

For effective control of air pollution, it is important to create public awareness about the ill-effects of air pollution Air pollution can be controlled by the following ways

i. Afforestation:

It means the establishment of new forests by planting on non-forest areas Forests are effective means to control air pollution because plants can filter and absorb air pollutants

ii. Modification of industrial effluents:

The air pollutants coming from industries should be passed through filters and other devices, so that the particulate matter is removed before the waste gases are released out. The smoke producing units should have long chimneys to take the

polluting gases far above and then disperse over a larger area. Industries should also invest for solar cookers or for producing bio gas

iii. Environment friendly fuels:

Lead-free fuels should be used in automobiles. Similarly, sulphur-free fuel should be used in coal-based industry to reduce pollution by sulphur dioxide

2. Water Pollution:

It is the change in the composition of water by the addition of harmful substances. Water pollution severely affects the health of people

Major pollutants of water:

Sewage is one of the major pollutants of water. It contains organic matter and the excreta of human and other animals. Organic matter encourages the growth of microorganisms which spread diseases

The wastes of industries (acids, alkalis, dyes and other chemicals) are disposed in nearby water bodies. These wastes change the pH of water and are harmful or even fatal to aquatic organisms

Certain industries release a lot of hot water from their cooling plants. It results in heating up of water bodies and kills aquatic life

Fertilizers and pesticides enter into water bodies with the rain water flow and the ground water by seepage. These chemicals remain in water for a long time and can enter food chains. They cause a number of diseases in animals

Oil tankers and offshore petroleum refineries cause oil leakage into water. Oil floats on the water surface and prevents atmospheric oxygen from mixing in water. So, aquatic animals begin to die due to oxygen shortage

Some heavy metals e.g. lead, mercury, arsenic and cadmium also make the water polluted. Such metals can be present in the water, released from industrial and urban areas

If water with such heavy metals is given to plants, the metals enter the vegetables that grow on these plants. Such contaminated vegetables are harmful for human health. Heavy metals reduce growth and development and cause cancer and nervous system damage. Mercury and lead can cause joint diseases such as rheumatoid arthritis, and diseases of kidneys, circulatory system and nervous system.

Effects of Water Pollution;

The following are major effects of water pollution

i. Eutrophication:

Enrichment of water with inorganic nutrients (nitrates and phosphates) is called eutrophication. The sewage and fertilizers contain large amount of inorganic material (nutrients). When sewage and fertilizers reach water bodies, the nutrients present in them promote algal blooms (excessive growth) there (Fig. 16.19). Rich algal growth leads to increase in the number of the decomposers. Decomposers use the oxygen present in water and it results in the depletion of oxygen. Algal bloom also reduces the light reaching the lower layers in water

ii. Food chain contamination:

The non-biodegradable water pollutants may stay in water for long times. From water, they enter into small organisms, which are fed upon by fish. The fish in turn are fed upon by land animals including human

iii. Epidemics:

Organic pollutants in water facilitate the growth of germs. Such polluted water causes epidemics like cholera, gastroenteritis etc.

Control of Water Pollution:

Public should be made aware of the dangers of water pollution. Before releasing the sewage into water bodies, it must be purified through sewage treatment techniques. Industrial wastes should also be treated before they are released into water bodies.

- **Abiotic:**

The non-living components of the environment like water, sunlight, soil, heat etc.

- **Acid Rain:**

The rain containing sulphuric acid and nitric acid, with pH range of 3 to 6

- **Ammonification:**

The decomposition of protein of dead plants and animals, and nitrogenous wastes to ammonia by ammonifying bacteria

- **Atmospheric nitrogen fixation:**

The conversion of atmospheric gaseous nitrogen to nitrates by thunderstorms and lightning

- **Biogeochemical Cycle:**

The cyclic pathway through which chemical elements move from environment to organisms and back to the environment

- **Biological nitrogen fixation:**

The conversion of gaseous nitrogen into nitrates by living organisms

- **Biosphere:**

The last level of ecological organization, all the ecosystems of the world together form the biosphere

- **Biotic:**

The living components of the environment, include producers, consumers and decomposers

- **Carbon cycle:**

The biogeochemical cycle in which carbon flows between organisms and the environment

- **Carnivore:**

The consumers which eat only animal flesh

- **Commensalism:**

A type of symbiosis in which one of the partners gets benefit while the other is neither benefited nor harmed

- **Competition:**

A symbiotic relationship between or among living things for resources, such as food, space, shelter, mate, ecological status, etc.

- **Consumer:**

The part of the biotic components of the ecosystem that consists of animals

- **Decomposer:**

An organism which decomposes the dead bodies and dead matter

- **Deforestation:**

Clearing of forests by natural causes or by humans

- **Denitrification:**

The conversion of nitrates into nitrogen gas which is then released into the atmosphere. This is caused by bacteria and how they obtain their energy. A small amount is converted to usable forms by lightning in a process called atmospheric nitrogen fixation

- **Ecological pyramid:**

A representation of the number of individuals or amount of biomass or energy present in various trophic levels of a food chain

- **Environment:**

The sum total of physical (abiotic) and biotic conditions which influence the organism

- **Eutrophication:**

The enrichment of water with inorganic nutrients, the nutrients promote the growth of algae and it leads to increase in the number of the decomposers and depletion of oxygen

- **Food chain:**

The series of organisms in an ecosystem, in which an organism eats the preceding one and is eaten by the next one

- **Food web:**

A network of interconnected food chains, has a number of feeding connections amongst different organisms of a community

- **Global Warming:**

Increase in the temperature of the Earth, due to the addition of greenhouse gases in atmosphere, which do not allow solar radiations to reflect back into the space

- **Interspecific interactions:**

Interactions between the members of the different species

- **Intraspecific interactions:**

Interactions between the members of the same species

- **Mutualism:**

The symbiotic association in which both the partners get benefit and neither is harmed

- **Natural resources:**

The resources on Earth, which provide everything that humans use or consume

- **Nitrification:**

The oxidation of ammonia to nitrites and nitrates by the nitrifying bacteria

- **Nitrogen cycle:**

The flow of nitrogen between environment and the organisms

- **Nitrogen fixation:**

Conversion of nitrogen into nitrates

- **Non-renewable resource:**

A resource that is formed over very long periods, the rate of formation is extremely slow so cannot be replaced. e.g. minerals and fossil fuels

- **Overpopulation:**

Increase in population beyond the carrying capacity of an area or environment

- **Ozone:**

The O_3 gas, also present in the upper layer of the atmosphere where it absorbs the ultraviolet rays present in the sun's radiation

- **Parasitism:**

A type of interspecific interaction in which smaller partner (parasite) derives food and shelter from the body of larger partner (host) and harms the host

- **Phytoplankton:**

Photosynthetic organisms that float on the surface of water

- **Pollutant:**

The substance that causes pollution

- **Pollution:**

Undesirable change in the physical, chemical or biological characteristics of air, water and land that may harmfully affect living organisms and other resources

- **Predation:**

An interaction between animals of two species or an pant and an animal, in which the predator attacks, kills and feeds on the smaller animal called prey

- **Producer:**

An organism that produces organic compounds from inorganic compounds, an autotroph

- **Pyramid of biomass:**

The graphic representation of biomass present per unit area at different trophic levels in an ecosystem

- **Pyramid of numbers:**

The graphic representation of the number of individuals per unit area at various trophic levels in an ecosystem

- **Renewable resources:**

The resources which are replenished or reproduced easily e.g. sunlight, air, wind etc

- **Symbiosis:**

Long or short term relationship between members of different species, three forms are parasitism, commensalism and mutualism

CHAPTER # 17 BIOTECHNOLOGY

Q1. Define biotechnology and describe its importance.

Ans: Biotechnology:

The use of living organisms in systems or processes for the manufacture of useful products or for services for humankind

Old Biotechnology:

Although the term biotechnology is new the discipline itself is very old Fermentation and other such processes, which are based on the natural capabilities of organisms, are commonly considered as old biotechnology

Modern Biotechnology:

Genetic engineering i.e. the artificial synthesis, modification, removal addition and repair of the genetic material (DNA) is considered as modern biotechnology

Scope and Importance of Biotechnology:

The following are some areas of the application of biotechnology

i. Biotechnology in the Field of Medicine:

In the field of medicine, biotechnologists synthesized insulin and interferon (antiviral proteins) from bacteria and released for sale A large number of vaccines and antibodies, human growth hormone and other medicines have also been produced Various enzymes are being synthesized for medicinal as well as industrial use Gene therapy (treatment through genes) has become important in recent years Biotechnology also proved much beneficial in forensic medicine The study of DNA helps in the identification of criminals.

ii. Biotechnology in the Field of Food and Agriculture:

Fermented foods (e g pickles, yogurt), malted foods (e.g powdered milk a mixture of barley, wheat flour and whole milk), various vitamins and dairy products are produced by using microorganisms. Wine and beer are produced in beverage industry Biotechnology has also revolutionized research activities in the area of agriculture

Transgenic:

Transgenic (organisms with modified genetic set-up) plants are being developed in which desirable characteristics are present e g more yields and resistance against diseases, insects and herbicides Transgenic goats chickens cows give more food and milk etc Many animals like mice, goats cows etc have been made transgenic to get medicines through their milk, blood or urine

iii. Biotechnology and Environment:

Biotechnology is also being used for dealing with environmental issues like pollution control, development of renewable sources for energy, restoration of degraded lands and biodiversity conservation Bacterial enzymes are used to treat sewage water to purify. Microbes are being developed to be used as biopesticides biofertilizers, biosensors etc Such transgenic microorganisms are also used for the recovery of metals cleaning of spilled oils and for many other purposes

Q2. Write a note on Genetic engineering.

Ans: Genetic engineering:

The artificial synthesis modification, removal, addition and repair of the genetic material (DNA) is considered as modern biotechnology It is done to alter the characteristics of organisms The work on genetic engineering started in 1944 when it was proved that DNA carries the genetic information Scientists isolated the enzymes of DNA synthesis and then prepared DNA outside cells

In 1970s they were able to cut and paste the DNA of organisms In 1978 scientists prepared human insulin by inserting the insulin gene in bacteria Human growth hormone was also synthesized in bacteria

In 1990 the **Human Genome Project** was launched to map all the genes in human cell The complete map of human genome was published in 2002

Interesting Information

Human began using microorganisms as early as 4000 BC for making wine vinegar cheese yogurt etc Some of these processes have become a part of every home that we may even hesitate to refer them as biotechnology

Interesting Information

In Scotland, in 1997 an embryologist Ian Wilmut produced a sheep (Dolly) from the body cell of an adult sheep

Q3. Give an example how biotechnology is helping for better environment.

Ans: See Q # 4 from Exercise (Short Questions)

Q4. Briefly explain the process of fermentation:

Ans: Fermentation:

The process in which there is incomplete oxidation-reduction of the organic substrate (glucose)

In 1857 Pasteur convinced the scientific community that all fermentations are the results of microbial activity He showed that fermentation is always accompanied by the development of microorganisms There are many kinds of fermentation and each kind is a characteristic of particular microbial group

Carbohydrate fermentation and its products

Fermentations are classified in terms of the products formed. The initial steps of **carbohydrate fermentation** are identical to those of respiration. The process begins with glycolysis, in which the glucose molecule is broken into two molecules of pyruvic acid. Different microorganisms proceed the further reactions in different ways. It results in the formation of various products from pyruvic acid.

Types of Carbohydrates Fermentation:

The two basic types of carbohydrate fermentation are

i. Alcoholic Fermentation (by yeast):

This fermentation is carried out by many types of yeast such as *Saccharomyces cerevisiae*. This process is quite important and is used to produce bread, beer, wine and distilled spirits. In this process, carbon dioxide is removed from pyruvic acid. The product i.e. acetaldehyde is then reduced to ethanol. The carbon dioxide produced during this fermentation causes the rise of the bread.

ii. Lactic Acid Fermentation (by bacteria):

In this process, pyruvic acid is reduced to lactic acid. It is carried out by many bacteria e.g. Streptococcus and many Lactobacillus species. It is quite important in dairy industry where it is used for souring milk and also for production of various types of cheese.

Interesting Information

Fears are also being expressed about the advances in biotechnology in terms of release of harmful organisms developed through recombinant DNA technology.

Q5. What are the products of the two types of carbohydrate fermentation?

Ans: See Q # 3 from Exercise (Short Questions)

Q6. How would you define fermentation with reference to biotechnology?

Ans: See Q # 1 from Exercise (Short Questions)

Q7. Describe the applications of fermentation in the field of fermented foods.

Ans: Applications of fermentation in fermented foods:

Fermentation often makes the food more nutritious, more digestible and tastier. It also tends to preserve the food, lowering the need for refrigeration. The following groups are included in the fermented foods.

i. Cereal products:

Bread is the commonest type of fermented cereal product. Wheat dough is fermented by *S. cerevisiae* along with some lactic acid bacteria.

ii. Dairy products:

Cheese and yogurt are important fermentation products. Cheese is formed when a milk protein is coagulated. This happens when the acid produced by lactic

acid bacteria reacts with milk protein Yogurt is made from milk by different lactic acid bacteria

iii. **Fruit and vegetable products:**

Fermentation is usually used, along with salt and acid, to preserve pickle fruits and vegetables

iv. **Beverage Products:**

Beer is produced from cereal grains which have been malted dried and ground into fine powder Fermentation of the powder is done by yeast This process breaks the glucose present in powder into pyruvic acid and then into ethanol Grapes can be directly fermented by yeasts to wine

Q8. Name any two industrial products made by fermentation. Also describe their uses in the industry.

Ans: See Q # 2 from Exercise (Short Questions).

Q9. What is a fermenter? What are the two types of fermentation carried out in fermenters?

Ans: See Q # 2 from Exercise (Understanding the Concept)

Q10. What are the Advantages of using Fermenters.

Ans: Advantages of using Fermenters:

For each biotechnological process, the environment provided to the organisms must be monitored and controlled Such a controlled environment is provided by fermenters

A fermenter optimizes the growth of the organisms by controlling many factors like nutrients, oxygen, growth inhibitors, pH and temperature

A fermenter may hold several thousand litres of the growth medium So fermenters allow the production of materials in bulk quantities

Massive amounts of medicines, insulin, human growth hormone and other proteins are being produced in fermenters and this production proves much inexpensive.

Interesting Information

The design and arrangements for continuous fermentation are more complex

Interesting Information

In fact fermenter constitutes the heart of any industrial fermentation process

Q11. Give introduction and objectives of genetic engineering.

Ans: Introduction of Genetic Engineering:

Genetic engineering or recombinant DNA technology involves the artificial synthesis, modification, removal, addition and repair of the genetic material (DNA) Genetic engineering developed in the mid-1970s when it became possible to cut DNA and to transfer particular pieces of DNA from one type of organism into another As a result, the characteristics of the host organism could be changed If host organism is a microorganism, such as a bacterium, the transferred DNA is multiplied many times as the microorganism multiplies. Consequently it is possible to obtain millions of copies of a specific DNA inside a bacterial cell

Objectives of Genetic Engineering:

The important objectives of genetic engineering are as follows

i. Isolation of a particular gene or part of a gene for various purposes such as gene therapy
ii. Production of particular RN A and protein molecules
iii. Improvement in the production of enzymes drugs and commercially important organic chemicals
iv. Production of varieties of plants having particular desirable characteristics
v. Treatment of genetic defects in higher organisms

Q12. What basic steps a genetic engineer adopts during the manipulation of genes?

Ans: See Q # 4 from Exercise (Understanding the Concept)

Q13. In biotechnology, what is meant by Genetically Modified Organism (GMO)? How is it made?

Ans: See Q # 5 from Exercise (Short Questions)

Q14. Describe the achievements of genetic engineering in medicine, agriculture and environment.

Ans: See Q # 3 from Exercise (Understanding the Concept)

Interesting Information

Before genetic engineering, 500 000 sheep brains were required to produce 5 mg human growth hormone

Q15. What are single cell proteins? Describe their importance.

Ans: See Q # 5 from Exercise (Understanding the Concept)

Interesting Information

It is known as single cell protein because the microorganisms used as production are unicellular individuals.

Interesting Information

SCP is gaining popularity day by day because it requires limited land area for production

MULTIPLE CHOICE

1. **Find the correct match for the fermentation product and the organism involved.**

   A Formic acid – Saccharomyces
   B Ethanol - Saccharomyces
   C Ethanol – Aspergillus
   D Glycerol - Aspergillus

2. **Which one is NOT an objective of genetic engineering?**

A Production of cheese and yogurt by lactic acid bacteria
B Isolation of a particular gene or part of a gene
C Production of RNA and protein molecules
D Correction of genetic defects in higher organisms

3. **Which of these is an anti-viral protein?**
A Urokinase B Thymosin
C Insulin D Interferon

4. **The first step in genetic engineering is;**
A Growth of the genetically modified organism
B Transfer of the Recombinant DNA into the host organism
C Isolation of the gene of interest
D Insertion of a gene into a vector

Answers

1. B	2. A	3. D	4. C

1. **How would you define fermentation with reference to biotechnology?**

Ans: Fermentation:

Fermentation is the process in which there is incomplete oxidation-reduction of glucose. Fermentation has been in the knowledge of man since centuries, but it was believed that it is purely a chemical process.

Fermentation in Biotechnology:

In beginning, the meaning of fermentation process was the use of microorganisms for the production of foods (cheese, yogurt, fermented pickles and sausages, soy sauce), beverages (beers, wines) and spirits. However in biotechnology the term "fermentation" means the production of any product by the mass culture of microorganisms.

2. **Name any two industrial products made by fermentation. Also describe their uses in the industry.**

Ans: Industrial Products:

Products	Microorganisms used	Some uses
Formic acid	*Aspergillus*	Used in textile dyeing, leather treatment, electroplating, rubber manufacture
Ethanol	*Saccharomyces*	Used as solvent, used in the production of vinegar and beverages
Glycerol	*Saccharomyces*	Used as solvent, used in the production of plastics, cosmetics and soaps, used in printing, used as sweetener
Acrylic acid	*Bacillus*	Used in the production of plastics

3. What are the products of the two types of carbohydrate fermentation?

Ans: Products of carbohydrate fermentation:

i. Alcoholic Fermentation (by yeast)

ii. Lactic Acid Fermentation (by bacteria

4. Give an example how biotechnology is helping for better environment.

Ans: Biotechnology and Environment:

Biotechnology is also being used for dealing with environmental issues like pollution control, development of renewable sources for energy, restoration of degraded lands and biodiversity conservation. Bacterial enzymes are used to treat sewage water to purify. Microbes are being developed to be used as biopesticides, biofertilizers, biosensors etc. Such transgenic microorganisms are also used for the recovery of metals, cleaning of spilled oils and for many other purposes.

5. In biotechnology, what is meant by Genetically Modified Organism (GMO)? How is it made?

Ans: Recombinant DNA is transferred to the target host. In this way, host organism is transformed into a genetically modified organism (GMO).

The GMO are provided suitable culture medium for growth to give as much copies of the gene of interest as needed.

The GMO contains the gene of interest and manufactures the desired product, which is isolated from culture medium.

UNDERSTANDING THE CONCEPT

1. Define biotechnology and describe its importance.

Ans: Biotechnology:

The use of living organisms in systems or processes for the manufacture of useful products or for services for humankind.

Old Biotechnology:

Although the term biotechnology is new, the discipline itself is very old. Fermentation and other such processes, which are based on the natural capabilities of organisms, are commonly considered as old biotechnology.

Modern Biotechnology:

Genetic engineering i.e. the artificial synthesis, modification, removal, addition and repair of the genetic material (DNA) is considered as modern biotechnology.

Scope and Importance of Biotechnology:

The following are some areas of the application of biotechnology.

i. Biotechnology in the Field of Medicine:

In the field of medicine, biotechnologists synthesized insulin and interferon (antiviral proteins) from bacteria and released for sale. A large number of vaccines and antibodies, human growth hormone and other medicines have also been produced. Various enzymes are being synthesized for medicinal as well as industrial

use. Gene therapy (treatment through genes) has become important in recent years. Biotechnology also proved much beneficial in forensic medicine. The study of DNA helps in the identification of criminals.

ii. Biotechnology in the Field of Food and Agriculture:

Fermented foods (e.g. pickles, yogurt), malted foods (e.g. powdered milk, a mixture of barley, wheat flour and whole milk), various vitamins and dairy products are produced by using microorganisms. Wine and beer are produced in beverage industry. Biotechnology has also revolutionized research activities in the area of agriculture.

Transgenic:

Transgenic (organisms with modified genetic set-up) plants are being developed, in which desirable characteristics are present e.g. more yields and resistance against diseases, insects and herbicides. Transgenic goats, chickens, cows give more food and milk etc. Many animals like mice, goats, cows etc. have been made transgenic to get medicines through their milk, blood or urine.

iii. Biotechnology and Environment:

Biotechnology is also being used for dealing with environmental issues, like pollution control, development of renewable sources for energy, restoration of degraded lands and biodiversity conservation. Bacterial enzymes are used to treat sewage water to purify. Microbes are being developed to be used as biopesticides, biofertilizers, biosensors etc. Such transgenic microorganisms are also used for the recovery of metals, cleaning of spilled oils and for many other purposes.

2. What is a fermenter? What are the two types of fermentation carried out in fermenters?

Ans: Fermenter:

A device that provides optimum environment in which organisms can grow to produce biomass and to form the product is called fermenter.

Types of fermentation carried out in fermenters:

Fermentation is carried out in fermenters, in the following two ways.

i. Batch Fermentation:

In this process, the tank of fermenter is filled with the raw materials to be fermented. The temperature and pH for microbial fermentation is properly adjusted, and nutritive supplements are added.

A batch fermenter

All the material is steam sterilized. The pure culture of microorganisms is added to fermenter from a separate vessel. Fermentation proceeds and after the proper time the contents of fermenter are taken out. Fermenter is cleaned and the process is repeated. Thus, fermentation is a discontinuous process divided into batches.

ii. Continuous Fermentation:

In this process, the substrate is added to fermenter continuously at a fixed rate. This maintains the microorganisms in growth phase. Fermentation products are taken out continuously (Fig 17.4).

A continuous fermenter

3. Describe the achievements of genetic engineering in medicine, agriculture and environment.

Ans: Achievements of Genetic Engineering in Medicine:

Various achievements of genetic engineering are as follows.

Human Insulin:

Human insulin gene was transferred into bacteria. The genetically modified bacteria became able to synthesize insulin. Diabetics are now receiving this insulin.

Human growth hormone:

In 1977 an E. coli bacterium was created that was capable of synthesizing the human growth hormone.

Hormone Thymosin:

The hormone thymosin which may prove effective against brain and lung cancer has been produced by genetically modified microorganisms.

Beta-endorphin:

Beta-endorphin, a pain killer produced by the brain, has also been produced by genetic engineering techniques.

Vaccine:

Genetic engineers produced a safe vaccine against the foot and mouth disease (a viral disease in cattle, goats and deer). Similarly many vaccines have been produced against human diseases such as hepatitis B.

Production of insulin through genetic engineering

Interferons:

Interferons are anti-viral proteins produced by cells infected with viruses. In 1980, interferon was produced in the genetically modified microorganisms for the first time.

Urokinase:

The enzyme urokinase, which is used to dissolve blood clots, has been produced by genetically modified microorganisms.

Haemophilia:

Now it has become possible to modify the genes in the human egg cell. This can lead to the elimination of inherited diseases like haemophilia.

To cure blood diseases:

Genetic engineering techniques can also be used to cure blood diseases like thalassemia and sickle-cell anaemia, which result from defects in single genes. Normal genes could be transferred into the bone marrow.

Achievements of Genetic Engineering in Agriculture:

Fix nitrogen:

Genetic engineers have developed plants that can fix nitrogen directly from the atmosphere. Such plants need less fertilizers

Achievements of Genetic Engineering in Environment:

Genetic engineering is also being used for dealing with environmental issues like pollution control, development of renewable sources for energy, restoration of degraded lands and biodiversity conservation. Bacterial enzymes are used to treat sewage water to purify. Microbes are being developed to be used as biopesticides, biofertilizers, biosensors etc. Such transgenic microorganisms are also used for the recovery of metals, cleaning of spilled oils and for many other purposes.

4. What basic steps a genetic engineer adopts during the manipulation of genes?

Ans: Basic Steps in Genetic Engineering:

All the above mentioned objectives can be obtained by some basic methodologies such as

i. Isolation of the gene of interest:

In the first step, the genetic engineer identifies the gene of interest in a donor organism. Special enzymes, called restriction endonucleases, are used to cut the identified gene from the total DNA of donor organism.

ii. Insertion of the gene into a vector:

A vector is selected for the transfer of the isolated gene of interest to the host cell. The vector may be a plasmid (the extra-chromosomal DNA present in many bacteria) or a bacteriophage. The gene of interest is attached with the vector DNA by using endonuclease (breaking enzymes) and ligase (joining enzymes). The vector DNA and the attached gene of interest are collectively called **recombinant DNA.**

iii. Transfer of recombinant DNA into host organism:

Recombinant DNA is transferred to the target host. In this way, host organism is transformed into a genetically modified organism (GMO).

iv. Growth of the GMO:

The GMO are provided suitable culture medium for growth to give as much copies of the gene of interest as needed.

v. Expression of the gene:

The GMO contains the gene of interest and manufactures the desired product, which is isolated from culture medium.

5. What are single cell proteins? Describe their importance.

Ans: Single-Cell Protein:

The protein content extracted from pure or mixed cultures of algae, yeasts, fungi or bacteria, the micro organisms are grown in fermenters where they produce a high yield of protein.

Importance of Single-Cell Protein:

a. Single-Cell Protein (SCP) refers to the protein content extracted from pure or mixed cultures of algae, yeasts, fungi or bacteria. For the production of single-cell proteins, the microorganisms are grown in fermenters. These microorganisms utilize

a variety of substrate like agricultural wastes industrial wastes natural gas like methane etc Microorganisms grow very vigorously and produce a high yield of protein The protein content produced by microorganisms is also known as novel protein or minifood

b. Due to over-population, the world is facing the problem of food shortage In future, the conventional agricultural methods might not be able to provide a sufficient supply of food (especially proteins)

c. For a better management of food shortage problems (in humans and domestic animals), the use of microbes as the producers of single-cell proteins has been successful on experimental basis This technique was introduced by Prof Scrimshow of Massachusetts Institute of Technology Scientist and food technologists believe that single-cell proteins will substitute the other protein-rich foods in human and animal feeds

d. All scientists recognize the significance of the production of single-cell proteins The microorganisms grow very vigorously and produce a high yield It has been calculated that 50 kilogram of yeast produces about 250 tons of protein within 24 hours Algae grown in ponds produce 20 tons (dry weight) of protein per acre/year This yield of protein is 10-15 times higher than soybeans and 20-50 times higher than corn When single-cell proteins are produced by using yeasts the products also contain high vitamin content

e. In the production of single-cell proteins, industrial wastes are used as raw materials for microorganisms It helps in controlling pollution

The use of single-cell proteins has good prospects in future because they contain all essential amino acids. Moreover, the production of single-cell proteins is independent of seasonal variations

- **Batch fermentation:**

The discontinuous fermentation process, divided into batches

- **Biotechnology:**

The use of living organisms in systems or processes for the manufacture of useful products or for services for humankind

- **Continues fermentation:**

A process in which cells or micro-organisms are maintained in culture in the exponential growth phase by the continuous addition of fresh medium that is exactly balanced by the removal of cell suspension from the bioreactor

- **Fermentation:**

The process in which there is incomplete oxidation-reduction of the organic substrate (glucose)

- **Fermenter:**

A device that provides optimum environment in which organisms can grow to produce biomass and to form the product

- **Genetically Modified Organism (GMO):**

The organism in which DNA (gene) from some other organism has been transferred

- **Recombinant DNA:**

The vector DNA and the attached gene of interest

- **Restriction endonucleases:**

Enzymes used to cut the gene from the total DNA of the organism

- **Single-Cell Protein:**

The protein content extracted from pure or mixed cultures of algae yeasts fungi or bacteria the micro-organisms are grown in fermenters where they produce a high yield of protein

- **Transgenic:**

Organisms with modified genome (genetic make-up)

- **Vector:**

(In Biology) The DNA (plasmid) or bacteriophage etc that transfers the isolated gene of interest to the host cell